SCIENTIFIC AMERICAN

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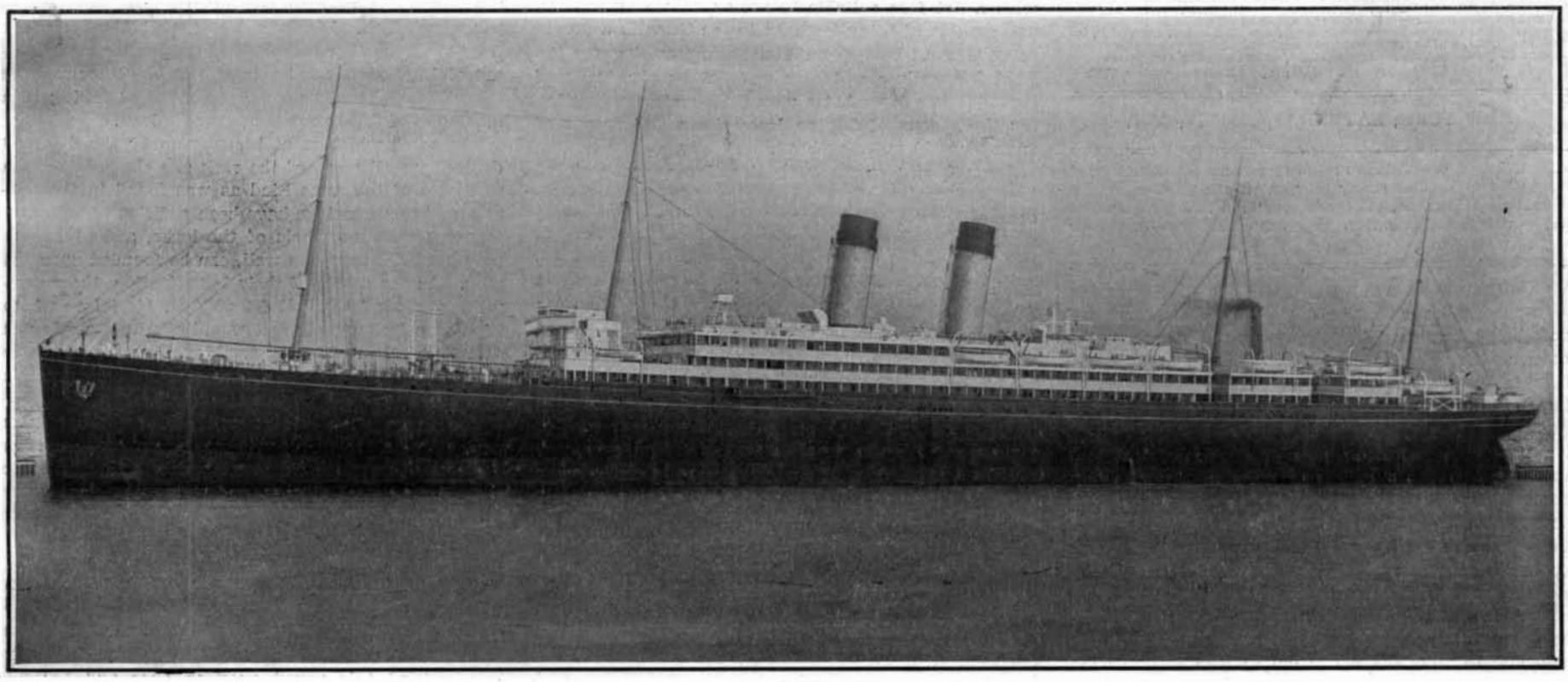
Vol. XCVI.—No. 21. ESTABLISHED 1845. NEW YORK. MAY 25, 1907. 10 CENTS A COPY $3.00 A YEAR.



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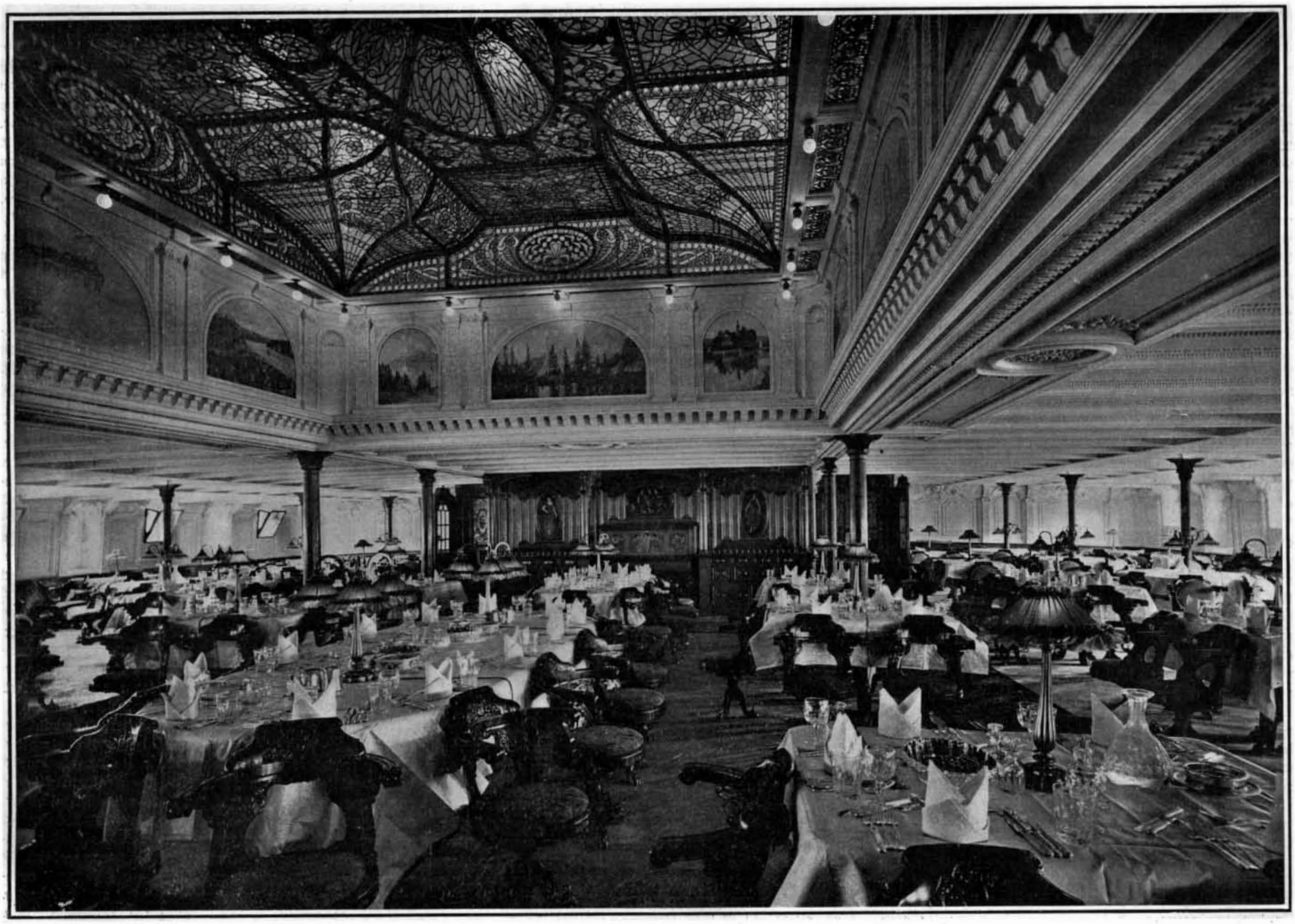

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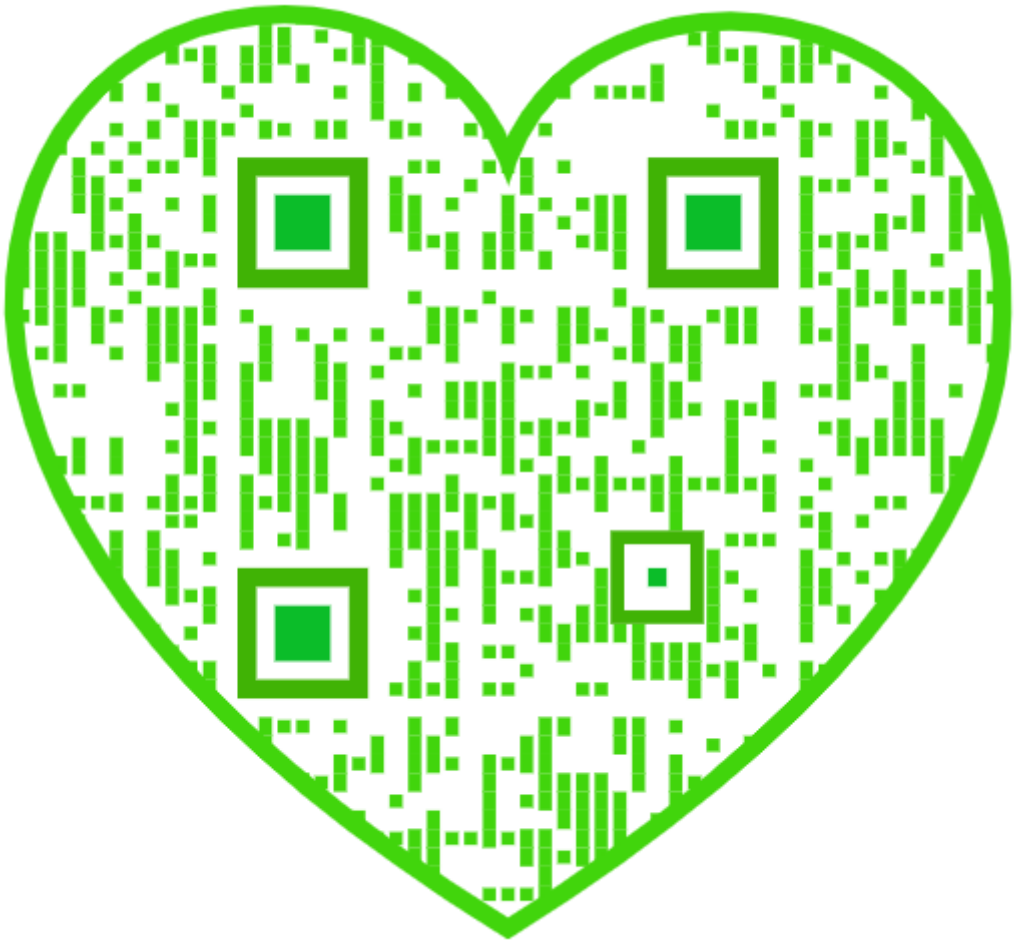
THE SPACIOUS DINING ROOM OF THE "ADRIATIC."—[See page 431.]



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ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

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Scientific American Supplement (Established 1876)..... 5.00 "
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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 25, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

NEEDED—A RATIONAL RAILROAD TRACK.

In our last issue we showed that the rails which are now being furnished by the mills are far inferior to those which were made a few years ago, and that to this fact, chiefly, is to be attributed the alarming increase in breakages. We also made it clear that the present Bessemer process, because of its limitations, is altogether unsuitable for the production of first-class rails, and that the only way open to the manufacturers to meet the present emergency is to abandon the Bessemer in favor of the open-hearth process, under which alone it is possible to make rails of the desired high quality.

But even if the above facts be admitted—and they cannot be denied—the fact remains that the roadbed and track of to-day are crude in design, and quite inadequate to meet the heavy duty which is laid upon them. Even the best of our Eastern tracks are subject to stresses which are far beyond those which are considered to be reasonable and safe in the general engineering practice of the day. We are certain that if an engineer who (we will suppose for the sake of argument) had never seen a railroad track were supplied with a statement of the weight, speed, concentrated wheel loads, and other data regarding modern railroad trains, and were asked to design a suitable and safe roadbed for the same—we are confident, we say, that he would design a structure very different from that upon which trains are run to-day. Certain it is that he would never adopt the T-rail with its wide, thin base, so inadequate to withstand compressive strains when it is bent in the reverse direction. Nor would he adopt a soft-wood tie. And if, for the want of other available material, he did use the wooden tie, it is certain that he would ridicule the idea that the miserable little spikes which we now use would be sufficient to hold the rails in place. Moreover, with one or two exceptions, he would reject the present methods adopted in splicing the ends of the rails.

It is certain that, if the very best track construction of the present day were offered for his consideration, he would reject it as being altogether inadequate for its work. He would find that the extreme fiber stress in the rails, subjected as they are to heavy impacts, is far higher, in fact, possibly two or three times as great as is permitted in the structure of a bridge. He would discover that there was the same excessive fiber stress in the tie; and that the bearing load on the ballast was also far beyond what was desirable.

As a matter of fact, we question if in the whole field of engineering, there can be found any construction of first-class importance which has received so little scientific investigation, take it as a whole, as modern railroad track. Certainly, it has received no such careful thought as the steel railroad bridge. If it has, we would very much like to know where is to be found a published document corresponding to Cooper's specifications for railroad bridges. No such paper exists, nor anything that approaches it. And yet, we do not hesitate to say that the steel rail, in view of the extraordinary duty that is laid upon it, and the perils attending its failure, and above all in view of the fact that it is continuous from end to end of the railroad, is a far more important element of the track even than the bridges themselves. The truth of the matter is, that for some reason which is rather difficult to determine, the track, although it lies literally at the very foundation of a successful railroad, has been left by the engineers very largely to work out its own salvation. Its present form, even to details (as witness the survival of the railroad spike) was determined by the exigencies of a day when railroading was a new and comparatively untried art; when technically-qualified engineers were scarce; and when the paucity of capital made it necessary to adopt the simplest and cheapest forms of construction. It was these considerations which led to the adoption of the flat-bottomed T-rail; for when once the use of cross-ties had been decided upon, necessitating that the rail should act as a continuous girder from tie to tie, good engineering would have suggested the use of some metal bearing plate upon each tie, and the construction of a rail with its bottom tensional member of a compact bulbous section, suitable to take the alternate compressive and tensile stresses to which it would be subjected. But this would have been too expensive a construction; and hence the necessity for a separate metal foundation plate was obviated by rolling the rail with a flat face suitable to act as a bearing surface, and capable of being fastened to the tie with a couple of good stout spikes—an admirable provision for the light locomotives and cars and the scanty funds of those pioneer days; but a very inadequate construction for these days of 200-ton locomotives and speeds of from 50 to 80 miles an hour.

An authority on track construction recently stated to the American Railway Engineering and Maintenance of Way Association that the proper rail to meet modern requirements would be one with a 6-inch base and 7 inches in height, and weighing 115 pounds per yard. Between rail base and tie should be a plate measuring 6¼ inches by 8 inches. The ties should have at least a 9-inch base; they should be spaced not over 20 inches center to center; and the bearing of the tie on the ballast should be reduced from the present 5 tons per square foot to 3.8 tons. This would give an increase in the rail alone of about 37 per cent of resistance. Such a track would be an advance, provided that the place of the spike were taken by some form of bolted connection, the bolts passing entirely through the tie, and not less than three bolts, two on the outside and one on the inside, being used at each tie plate.

EXCELLENT FOUNDATIONS FOR THE GATUN LOCKS.

The particular storm center around which has raged the fiercest of all the technical controversies of the Panama Canal, is to be found at the Gatun dam and locks; and, of all the questions debated in this connection, perhaps the most important is that of the character of the rock underlying the site of the locks. The opponents of the high-level canal, and notably Mr. Lindon W. Bates, have bitterly opposed the creation of the Gatun Lake, mainly on the ground that the character of the whole underlying ground throughout the 7,000 or 8,000 feet covered by the dam and locks was unsuitable, either to carry the heavy superincumbent load of the structures, or to resist the tendency of the impounded waters to break through by extensive seepage through the subsoil. Mr. Bates has claimed, moreover, that the hill which has been chosen for the site of the locks does not present a sufficient length, measured along the axis of the locks, to contain the whole structure from entrance to entrance.

For many months past an extensive series of borings has been made at the site, and several test-pits have been sunk to the full depth of the lowest lock foundation, the latter being constructed of sufficient size to allow the engineers to descend and make an inspection of the successive strata of ground as thus exposed to view. Furthermore, these test-pits render it possible to excavate the material in large enough masses to make adequate tests to determine the bearing power of the rock and its permanence when exposed to the atmosphere.

When the borings and test-pits were completed, and with a view to a final determination of the question, a special committee composed of three of our leading hydraulic engineers, Messrs. Alfred Noble, chief engineer of the East River tunnels of the Pennsylvania Railway Company; Frederick P. Stearns, of Wachusett Dam fame, and John R. Freeman, who was largely responsible for the adopted plans of the new Catskill water supply of this city, went to the Isthmus, and after an exhaustive examination have reported favorably to the Secretary of War. Not only does the report remove the very serious doubts which have been aroused by the criticism above referred to; but it discloses apparently an even better condition of things than the sponsors of the Gatun dam and locks had supposed to exist. These engineers, individually, entered each of the test-pits, the deepest of which was extended to a depth of 87.4 feet, and they found that after passing through a few feet of overlying clay, the pits entered a rock formation and continued in the same to the bottom. Timbering was required only in the overlying clay, except in one or two cases, where it extended for a few feet below it; but from the clay down to the bottom of the pits the rock was standing well in the vertical walls, and this in spite of the blasting which is required during excavation.

With one exception the rock is of a fine-grained, bluish-gray, argillaceous sandstone character, being, in fact, the same material that has often been referred to as indurated clay. In hardness it may be compared with some of the clay shales; but it is massive rather than laminated. The exception mentioned was a conglomerate rock found in the lower eight feet of the first test pit. Although a small amount of water filtered into each of the pits, in no case was the quantity large enough to be of practical importance. During the visit of the engineers, a test of the supporting power of the rock was made by loading one square foot of a portion which had been uncovered in making the excavations with 72,000 pounds of steel rail. This weight, although it was several times as great as that which would come upon an equal surface under the walls at this lock, caused no appreciable indentation upon the surface of the rock.

Seven samples of the conglomerate from the first pit showed an average bearing power of 867 pounds per square inch. Five samples of the bluish-gray rock from the four other test-pits failed at an average pressure of 1,686 pounds to the square inch. Other samples taken from the pits showed no signs of failing at a maximum of 6,000 pounds per square inch.

The cores which were brought up by the diamond drills from all parts of the rock site showed that the rock was of the same kind as was found in the test-pits, and these borings have been sufficiently extensive to prove that the whole of the locks, and at least a portion of the approach wall, can be founded upon the rock. As the result of their investigation, these engineers expressed the belief that the material on which the Gatun locks would rest would afford an ample and safe foundation. Equally good results were shown in the test-pit and borings at the site of the regulation works in the center of the dam.

The Pedro Miguel locks will rest, for the greater part of their length, upon a hard trap rock, and for the rest of their length upon a softer rock similar to that at Gatun. The rock underlying the Sosa locks was shown by several excavations and by borings to be so satisfactory, that no test-pits were considered to be necessary.

The high professional standing of the board of engineers, the thorough character of the sub-surface examination, and the highly favorable character of the findings, may be taken by the American public to have settled this vexed question once and for all. With this out of the way, the last of the serious uncertainties as to the ultimate and satisfactory completion of this great work may be considered to have been removed.

THE SMOKE PERIL AT FIRES.

If New York still cherishes the delusion that it has the best-equipped fire department in the world, the fire which recently ruined the building of a well-known firm of typewriter makers ought certainly to shock the fire department to a livelier sense of their error. The fire in question entailed no loss of life, yet it taxed to the utmost the resources of the fire brigades of the lower part of the city, and tested the courage of the men whose duty it was to save the structure. It was not fierce heat that they were called upon to combat, but dense smoke and suffocating gases. More than forty firemen were dragged out from the building by their comrades, stupefied and unconscious, and laid out on the sidewalk until they recovered sufficiently either to be taken to hospitals or to return to their duties. The delay which this rescue work naturally occasioned, and which resulted no doubt in some loss to the owners of the building, would lead one to suppose that smoke helmets and respiratory apparatus were never invented, or at least never heard of in New York. Yet for years self-contained breathing apparatus has been used in various industries by operatives who are hourly compelled to face dangers compared with which the perils of this fire seem trifling. In mines saturated with poisonous fire damp, in gas and chemical works where noxious fumes are generated in dangerous quantities, in sewers, coal bunkers, and ammonia chambers, breweries and well-sinking plants, men work with little inconvenience, all because they are equipped with apparatus for supplying an adequate amount of fresh air or oxygen. The fire brigades of Europe have used such breathing devices with conspicuous success; and yet the richest city in the most enterprising country in the world still displays a lamentable reluctance to use inventions which so far from being untried, have proven their worth in many a perilous trade.

The type of breathing apparatus which would be required by firemen would probably be the simplest kind of respiratory device, because its wearer would be compelled to pursue his task for a comparatively unprotracted period. Cost can hardly be offered as an argument against the adoption of breathing helmets. One type of European apparatus, which has done excellent service in various colliery explosions, weighs 29 pounds, costs $40, and enables its wearer to work comfortably in a suffocating atmosphere for an hour and a half. Less expensive and equally serviceable is a respiratory apparatus invented by three German scientists after a careful study of the requirements which must be met by smoke jackets and helmets. Their contrivance weighs but three pounds, costs about $10.

and will enable a fireman to breathe in a smoke-laden atmosphere for a period varying in duration from thirty minutes to an hour and a half, depending upon the violence of his exertions. In this apparatus the oxygen is regained from the exhaled carbonic acid and water vapor and produced at a rate proportional to the rate of their production in the body, so that the time during which respiration can be maintained is a function of the work done. This automatic power of adaptation to the demand for oxygen is one of the most important advantages of this system.

Other systems have been invented which have also been successfully used, and which limitations of space forbid our mentioning here. The fact remains that among a dozen appliances for successfully enabling a fireman to fight his way through choking gases and smoke, one must surely be found which can be used by the New York fire department.

THE AMERICAN MUSEUM OF SAFETY DEVICES AND INDUSTRIAL HYGIENE.

BY WILLIAM H. TOLMAN, PH.D., DIRECTOR.

As early as 1867 Dolfus, a French industrialist, aroused by the increasing number of accidents to labor in factories and workshops due to the fact that there was little or no attention paid to the safeguarding of dangerous machinery, organized an association for the prevention of accidents, and founded what was the beginning of a museum of safety devices. To-day some of these original models may be seen in an honored section of the Paris Museum of Safety Devices. In 1890 a museum of safety devices was opened in Vienna; in 1893 a second in Amsterdam, followed by similar organizations in Munich, Berlin, Moscow, Zurich, Paris, and Milan.

As a member of the International Jury in Social Economy at the Paris Exposition in 1900, I studied the exhibit of the Amsterdam museum of safety devices and familiarized myself with this new movement for safeguarding life and limb. Becoming deeply impressed with the significance in preventing fatalities and casualties in the industrial world, I felt convinced that its practical application in our own factories and workshops would be the means of saving many lives and limbs. Through the medium of the American Institute of Social Service, the idea of this new kind of museum was introduced into America, and became a part of its plan to work for the establishment of such an institution in our country. Lectures were given, articles written and conferences held to arouse the public to the necessity of an American museum of safety devices.

Through the co-operation of Morris K. Jesup, president of the American Museum of Natural History, one of the exhibit halls was placed at the disposal of the American Institute of Social Service from January 29 to February 12, 1907, for an exposition of safety devices and industrial hygiene. There were some 200 entries of devices for safeguarding the lives and limbs of workmen and preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. There were many "live exhibits," that is machines or devices in operation, models of actual or reduced size, and photographs; wood- and metal-working machinery; polishing machines; presses; safeguarded elevators; safety lamps and non-explosives; fire safety devices, and railway appliances.

The section of industrial hygiene included improved dwellings; first aid to the injured; prevention of tuberculosis and other dread diseases harmful to the life of workmen; respirators and devices for supplying and maintaining pure air and industrial betterment.

It was the object of this first exposition to direct the attention of the American public to the necessity of doing something to lessen the causes of accidents to American life and labor by means of a permanent museum of safety devices, where all problems of safeguarding life and limb can be studied in their working details, and to stimulate the need of invention of new devices to meet new conditions of danger and peril.

The committee of honorary vice-presidents included ex-President Grover Cleveland, Hon. E. C. Stokes, governor of New Jersey; Hon. C. P. Neill, United States Department of Labor, Washington, D. C.; H. C. Bumpus, director American Museum of Natural History; Hon. Curtis Guild, Jr., ex-governor of Massachusetts; Hon. Henry Roberts, governor of Connecticut; Hon. T. P. Sherman, labor commissioner of the State of New York.

A ladies' committee was organized, under the honorary chairmanship of Mrs. Douglas Robinson, including Mrs. Joseph H. Choate, Mrs. Grover Cleveland, Mrs. W. Bayard Cutting, Mrs. Charles E. Hughes, Mrs. Seth Low, Mrs. George B. McClellan, Mrs. J. Pierpont Morgan, Mrs. Levi P. Morton, Mrs. William J. Schieffelin, Mrs. Lorillard Spencer, Mrs. I. N. Phelps Stokes, Miss Amy Townsend.

As a result of the first international exposition, an advisory council has been organized under the chairmanship of C. Kirchoff, of the Iron Age, and the vice-chairmanship of T. Commerford Martin, of the Electrical World. The other members are F. S. Halsey, of the American Machinist; H. W. Desmond, the Architectural Record; J. R. Dunlap, the Engineering Magazine; W. R. Ingalls, Engineering and Mining Journal; C. W. Baker, Engineering News; J. M. Goodell, the Engineering Record; A. Spies, Electrical Record; C. W. Price, Electrical Review; F. Webster, Insurance Engineering; F. E. Rogers, Machinery; S. S. McClure; F. R. Low, Power; W. H. Boardman, Railroad Gazette; A. Sinclair, Railway and Locomotive Engineering; A. A. Hopkins, SCIENTIFIC AMERICAN; H. W. Blake, Street Railway Journal; E. F. Roeber, Electrochemical and Metallurgical Industry; G. Gilmour, the Travelers' Insurance Company; James H. McGraw, president McGraw Publishing Company; Charles T. Root, president Textile Publishing Company; H. M. Swetland, president of the Automobile.

One of the most encouraging signs of the moral uplifting of the race is the unmistakable growth in these later days of the humanitarian sentiment. The dignity of the human body, the sanctity of human life, are swiftly emerging to their full and proper recognition. The reproach has lain too long at our doors that, as a people, we were so madly bent on the pursuit of wealth that we cared little who might fall by the way, if only the goal were swiftly and grandly won. To the question: "How much then is the life of a man worth more than a sheep?" we have made answer by rolling up a record of over half a million annual maimings and killings that may well put us to the blush. Therefore it is gratifying to realize that the movement set on foot by the American Institute of Social Service for the promotion of an American museum of safety devices is meeting with marked success.

In view of the fact that a very large percentage of the accidents is absolutely preventable, the editors of the SCIENTIFIC AMERICAN decided to offer a gold medal, annually, for the best device for the protection of life and limb produced during the year; this award to be given by the American Museum of Safety Devices after the board of experts have passed upon the devices submitted. The medal, shown in the center of the group, will be 2⅝ inches in diameter, and shows on the obverse the genius of invention rewarding the inventor of some device for saving the life of a factory operative, while a second allegorical figure conveys the supreme honor of a laurel wreath. Our engraving also shows two somewhat similar designs. The middle one has been accepted with slight modifications as to modeling. A committee of nine has been appointed by the executive committee to award this medal, having full power to limit the field of award and establish such conditions as seem necessary. Three new members are to be appointed to this committee each year, taking the places of three who will retire. The conditions of the competition will be announced very soon. A second gold medal has been offered by Francis H. Richards, the inventor, for the best invention to be exhibited at the museum for safeguarding life and limb, the field of effort for this award to be limited to automobiles and motor boats. Dr. L. L. Seaman has offered an annual prize of $100 for the best essay on the subject of safeguarding life, intending that the essay shall be a study of existing conditions and methods for their improvement. One check for $5,000 has been received from an anonymous giver, from a city outside of New York.

The following jurors, recommended by the advisory council, were unanimously appointed by the executive committee of the American Museum of Safety Devices:

Jury for the SCIENTIFIC AMERICAN Medal: H. H. Westinghouse; John Hays Hammond, president of the American Institute of Mining Engineers; Samuel Sheldon, president of the American Institute of Electrical Engineers; Prof. F. R. Hutton, president of the American Society of Mechanical Engineers; Cornelius Vanderbilt; Stuyvesant Fish, George Gilmour.

For the Richards Medal, for the best safety device in the field of automobiles and autoboats: Colgate Hoyt, president of the Automobile Club; Edward J. Schroeder, president Motor Boat Club of America; Dr. S. S. Wheeler; Caspar Whitney, and A. G. Batcheller, editor Automobile.

For the award of the $100 prize offered by Dr. Seaman: Dr. Josiah Strong; Dr. A. C. Humphreys, president of Stevens Institute of Technology, and James A. Hill, president of the Hill Publishing Company.

The museum will open in the autumn, in the new 39th Street building, having rented the entire third floor from the McGraw Realty Company. From there, it is the hope that it will soon have a building of its own, where there will be room, not only for devices of all kinds, but rooms for instruction, lecture hall, and a laboratory where safety device ideas can be worked out practically in accordance with the requirements of American needs, that is, simple, cheap, and those that in no way interfere with the high speed of the machinery.

As was recently remarked in an editorial in a technical journal, "the initial step has been taken, and it only remains to obtain funds to make it of instant and permanent benefit. It is estimated that the very modest sum of $25,000 would cover the expenses of the first year's campaign, and when this amount has been raised and expended, it is reasonably expected that the growth of the work will be assured, and further funds for its maintenance contributed without much soliciting. For the present, however, means are scarce, and the support of all who can be reached is earnestly solicited. An appeal is now being made to manufacturers and operators of industrial plants and public utilities through the papers they read, to give their material assistance as speedily as possible, in amounts from the smallest to the largest they are inclined to give. The return from the investment scarcely needs to be pointed out. The humanitarian side will be justification enough to the majority, but there is the additional and more direct pecuniary reward in the reduction of liabilities to damage suits."

Tentative Design. The Accepted Design. Tentative Design.

THE SCIENTIFIC AMERICAN MEDAL FOR SAFEGUARDS FOR LIFE AND LIMB.

EXTRAORDINARY INSECT ENLARGEMENTS.

BY WALTER BEASLEY.

Among the noteworthy and curious objects shown during the recent meeting of the American Scientists at the New York Academy of Sciences Exhibition held in the Museum of Natural History, New York, was a remarkable series of enlarged wax models of the little-known and peculiar-form insects called tree-hoppers (Membracedæ) of the family of Hemiptera. Nothing on so large a scale and so satisfactory in the way of graphically portraying the unsuspected and hidden wonders so strikingly possessed by these tiny fantastic creatures has hitherto been attempted in entomological work. In fact, they are new and surprising revelations in craftsmanship. The production of these unique creations is due to Mr. Ignaz Matausch, a handicraftsman in the Section of Preparation in the Museum of Natural History, and working under the direction of Dr. B. A. Dahlgren, assistant curator of invertebrate zoölogy. The models were executed at leisure hours away from regular routine duties, and are intended largely as an experiment in an original and difficult class of work, designed principally for college and museum exhibits. In a recent interview with Mr. Matausch, in his home studio, the writer obtained the first series of photographs of his remarkable wax models, together with a general description of his methods and technique.

For some reason scientists seem never to have tabulated in full their observations of these curious creatures. Prof. William Morton Wheeler, curator of invertebrate zoölogy of the American Museum of Natural History, kindly favored the writer with some highly instructive and interesting notes as to their life habits. He says: "The insects known as tree-hoppers (Membracedæ) belong to the great group of Rhynchota which have sucking mouth-pieces and an incomplete metamorphosis. They live on the juice of plants which they extract from the stems by means of their sharp beaks. When fully grown, they are provided with wings, but when young are wingless. They are especially interesting on account of the peculiar development of the thorax, which in grown specimens is provided with singular horns or protuberances. These horns are often so peculiarly and extravagantly developed that entomologists have hitherto been unable to account for their development and form. They remind one of some of the highly specialized horns and tusks in fossil reptiles and mammals. It is difficult to conceive of their being used by the animal in any way. It has been suggested that they represent a tendency of the animal in its development, to become monstrous and extravagant (hypertelic). These peculiar developments are not so clearly seen in tree-hoppers of temperate regions as they are in the species from the tropics of South and Central America, where they are often extraordinarily developed."

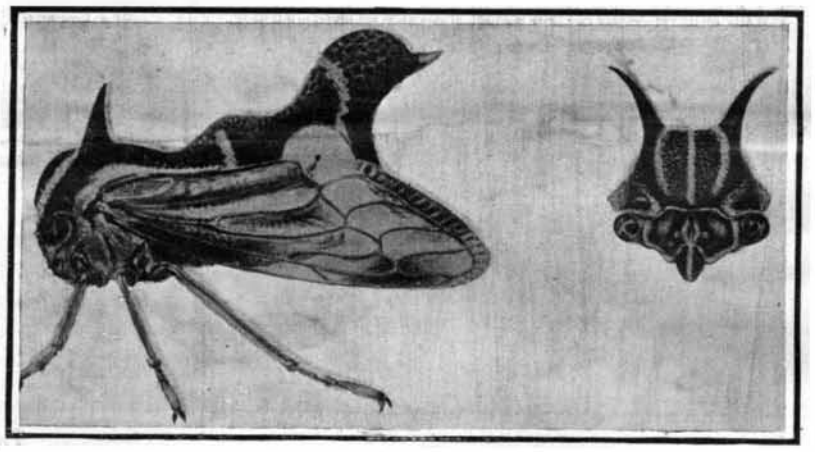
In the models the extraordinary developments mentioned by Prof. Wheeler are spectacularly evident. Nature has evidently devised and equipped them in one of her most rollicking and fantastic moods, for she has furnished them with topsy-turvy and contortionate bodies. They have four wings and four eyes, two of the latter large, and two partly developed. Many of these insects have humps on their backs; the prothorax is prolonged backward like a roof over the body, often quite covering it. Their two large eyes always have a keen, droll look and the line that separates the head from the prothorax gives them the appearance of wearing glasses. In some instances, the prothorax is an elevated night-cap, in others it is shaped like a Tam O'Shanter, and sometimes it has horns, one on each side. The mouth points are formed for piercing and sucking, and have the appearance of a beak. This beak consists of four bristles, inclosed in a fleshy jointed sheath. The young nymphs re-

Mr. Matausch at Work.

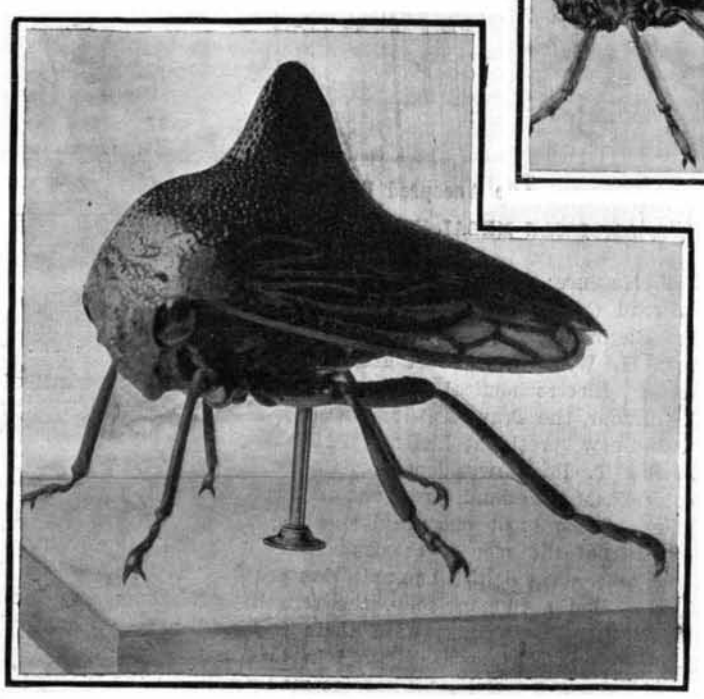
semble the adults more or less closely in form. They live on plants, bushes, and small trees. They are great leapers—hence their common appropriate name of "tree-hoppers." Some species deposit a sort of honey-dew and their presence is usually followed by ants. They are not usually found in sufficiently large numbers to constitute pests, like others of the same order.

When about to construct a model, the artist selects the particular insect from a small wooden box, where each individual is kept labeled and mounted. They vary in size from that of an ant, more or less, and nearly all require the use of a microscope and pocket lens to work out and clearly define their minute organism. The specimens are all obtained from one special dealer in Germany, having agents in various tropical parts of South and Central America, Mexico, India, and elsewhere. The trapping of these hopping and wiry creatures, whose presence none but the experienced native collector can detect, is difficult, as many render themselves inconspicuous in order to escape the detection and vigilance of their enemies. They bore into the plants and their bodies frequently take on the color and hue of their surroundings. Mr. Matausch has over a hundred representative specimens at present. A keen interpreter of nature, a skillful modeler, and a perfect colorist, Mr. Matausch is able to transfer deftly and imitate correctly the brilliant and variegated hues of his miniature originals, and so to fashion his magnified portraits that no exaggeration in facial expression, shape, or luminosity mars or distorts their lifelike appearance. The first constructive step is that of making an enlarged scale drawing of the desired size of the intended model of the insect. This is followed by removing the wings and legs. Then the body of the insect is divided or split in two parts. Each of these separate dissected parts is measured, drawn to certain dimensions, and afterward worked up in clay to correct proportions, from which models plaster casts are made. These rough casts are next cleaned and assembled, forming only the general outline and crude exterior of the insect. This is followed by an application of the plastic material, a special wax preparation, which is worked up and modeled to the finest detail, so that in measurement and shape it corresponds in every point with the finished sketch. This requires the most patient, skillful, and delicate modeling in order to bring out the hundreds of indentures, cavities and lines which go to make up the marvelous outer livery of these creatures. The final process is that of painting, and in this Mr. Matausch is especially clever in perfectly reproducing nature's color scale in the outer coat of the models. To give greater permanency and also to improve the colors, the painted surface is gone over either with a dull or shiny varnish. The figures are enlarged fifteen diameters, more or less, according to natural size. Of the six here shown five are from different tropical parts and one native from Ohio, the latter in decided contrast, being a species without the peculiar development possessed by the exotics. The accompanying pictures show to clear advantage the grotesque appearance and the peculiarly shaped bodies without further detailed description. Special mention should be made, however, of the extraordinary and fantastically shaped individual from Sikim, India, having an immense, long, curved, tusk-like continuation of the prothorax, extending the full length of the body. Probably the most wonderful and mysteriously shaped of all is the specimen from Mexico, with four large spindle-shaped balls, two having long, pointed projections. For a droll and comic look with imitation spectacles the Brazil specimen is decidedly unique.

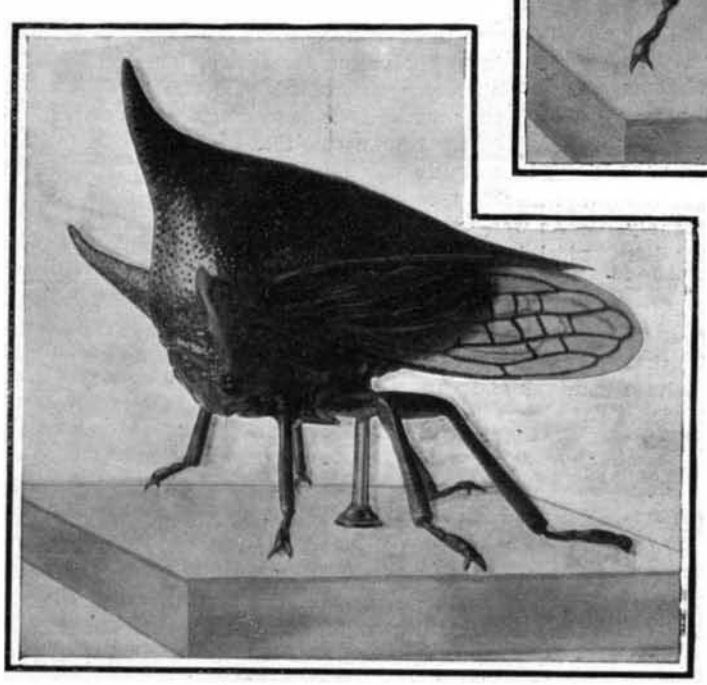
An idea of the expenditure of time bestowed upon this class of work may be imagined from the fact that nearly a month of patient and critical labor, requiring superior skill, delicate sculpture, modeling, drawing, painting, and plaster casting, was consumed in the production of a finished model.



Water Color Drawing of Heteronotus Abbreviatus, from Mexico.



A Hump-Backed Specimen from Ohio.



A Three-Horned Type from Peru.

EXTRAORDINARY INSECT ENLARGEMENTS.

Terminal Problems in New York.

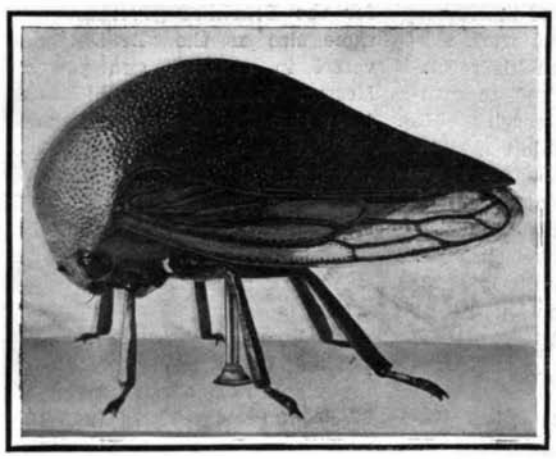
BY A. S. ATKINSON.

The railroad terminal problems have always been difficult to solve in New York city, and in the past quarter of a century many millions of dollars have been wasted through mistakes and makeshifts. Not a single railroad until recently has adequately measured the traffic over a series of years, and there has been a frantic movement to do an enormous business with inadequate space and accommodations. Every railroad man recognizes the fact that the Pennsylvania tunnel should have entered New York ten years ago, and the Vanderbilts acknowledge their mistake in not enlarging their Grand Central depot and yards years ago, instead of patching it up in the effort to keep pace with the growing traffic.

Expenditures within two years by the railroads entering New York city and Jersey City, together with new outlays planned by the same lines, will bring the fresh investments in New York terminals far above $125,000,000. It is not too much to place this total at $150,000,000, for already the companies are realizing that their first plans will need modifications, and new extensions will be required. The early estimated prices on the improvements of the terminals of the Pennsylvania, New York Central, Erie, Delaware, Lackawanna & Western, and the Long Island road have all proved too small. It is a question with some practical railroad men whether even the present huge expenditures for terminals will suffice for more than ten or fifteen years at the utmost.

The handling of the New York city traffic has al-

ways been a tremendously heavy expense to the railroads, but in the end it is most profitable. The mistakes have been due to lack of proper provision for the future. The growth of the city has been beyond all expectation, and no one has been able to forecast the future even approximately. The waste on tinkering with inadequate terminals is variously placed at $30,000,000 to $40,000,000, or about $3,000,000 to $4,000,000 a year in the past ten years. The New York Central has been the heaviest loser in this respect, but all of the roads have had their share in the waste. The present lavish expenditures of the roads have come all within a few years, when they should have been distributed over a long series of years. To make this great investment in improved terminals pay, the roads must increase their earnings something like $6,000,000 a year. The question of whether this increase can be made is one that worries a few of the railroad officials, but others have perfect confidence in the future traffic.

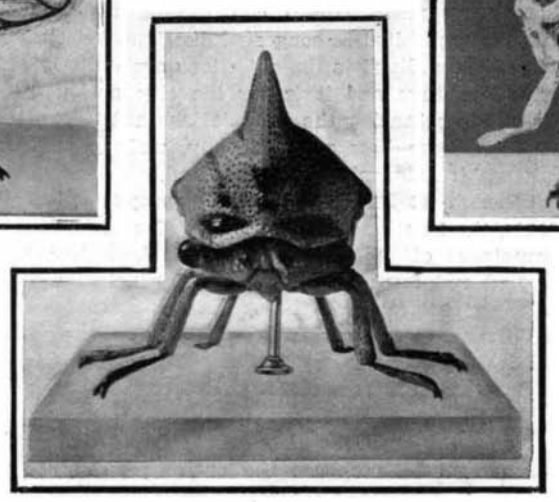


A Type of Tree-Hopper Found in Brazil.

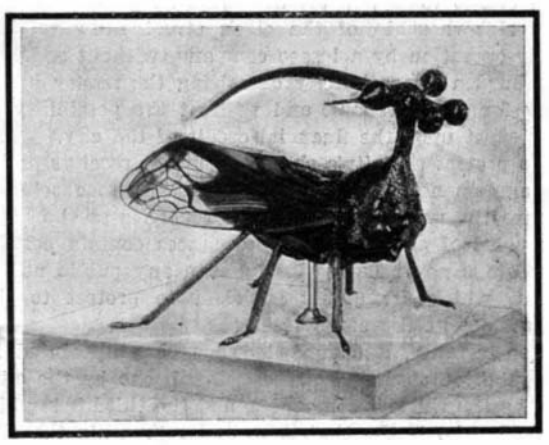
The latter base their confidence upon facts and figures of traffic which indicate what New York has actually lost through inadequate terminal facilities in the past. The drygoods merchants assert that New York has lost the handling of about $25,000,000 worth of drygoods within the last two or three years through the delays due to shipping through the city, as the goods have been forwarded by other routes or by water. The trucking bill of New York is estimated annually at $35,000,000, and much of this should have gone to the railroads in the past through better terminals and economical connections with each other's lines. The transatlantic lines are complaining that the import business has been seriously hampered in recent years by the inadequacy of the railroads to handle it. The steamship companies have gone to great expense to construct piers and docks in New York harbor, but if the roads cannot handle their freight satisfactorily, they will make some other port their terminal. Indeed, Baltimore, Philadelphia, and Boston have already taken a good deal of the transatlantic freight simply on this account. Out of $776,000,000 worth of merchandise imported last year, only $40,000,000 passed through without paying toll here, but the shippers have grumbled at the handling, and threaten to divert more traffic to other ports.

At the present moment a visit to the terminal yards of any one of the great railroads entering New York or Jersey City will show a most remarkable sight. Nearly every foot of the switches is occupied with loaded cars waiting to be unloaded. They are delayed in many instances because the piers are so loaded with freight that nothing can be done to relieve the congestion. A recent snowstorm in New York — the heaviest that has visited this section for many a year—served to demoralize the freight far more than the passenger traffic. This latter got in normal operation again within twenty-four hours; but not so the freight. The stalled cars could not move, because the trucking in the city was tied up. The cars standing on the switches could not discharge their cargoes, and others were strung out on miles of switches at nearly every way station thirty miles out. So the trucking business is responsible often for freight congestion, and this needs improvement and enlarging as well as the railroad terminals. An underground system of freight tunnels would thus tend to relieve the situation mightily, and this would operate independent of storms and other accidents.

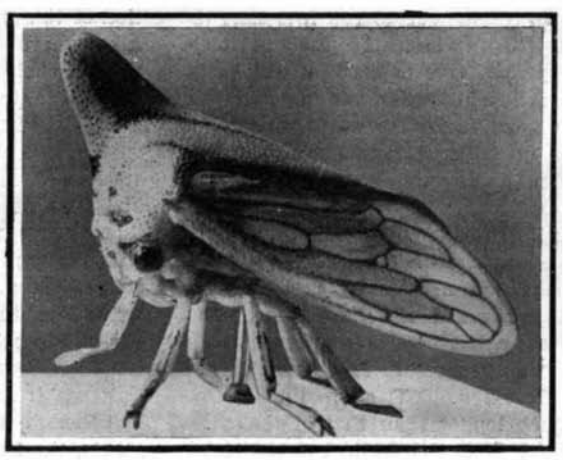
The cost of living in New York is high, and against it bitter complaints are often voiced. But the reason for this is not far to seek. The same congestion which makes even a small snowstorm a dreaded visitation causes the soaring of prices for almost every article of food. It costs $7 a day to maintain a two-horse truck. Such a truck will often stand from four to six hours at a pier or railroad terminal waiting for its turn to cart away freight. Who pays for this waste of time? Certainly not the teamster nor the owner of the goods. The consumers—they pay the freight. With more adequate terminal and dock facilities, all of this long waiting in line could be prevented. There would be ample space for a dozen teams to load up where there is room to-day for only one. The cost of trucking during snowstorms is frequently doubled in the course of a day. Some estimate the increased cost of foods through trucking during a snowstorm something like $300,000 a day.



A Full Front View of a Brazilian Specimen, Characterized by Its Odd, Spectacled Appearance.



A Curiously Shaped Insect from Mexico.

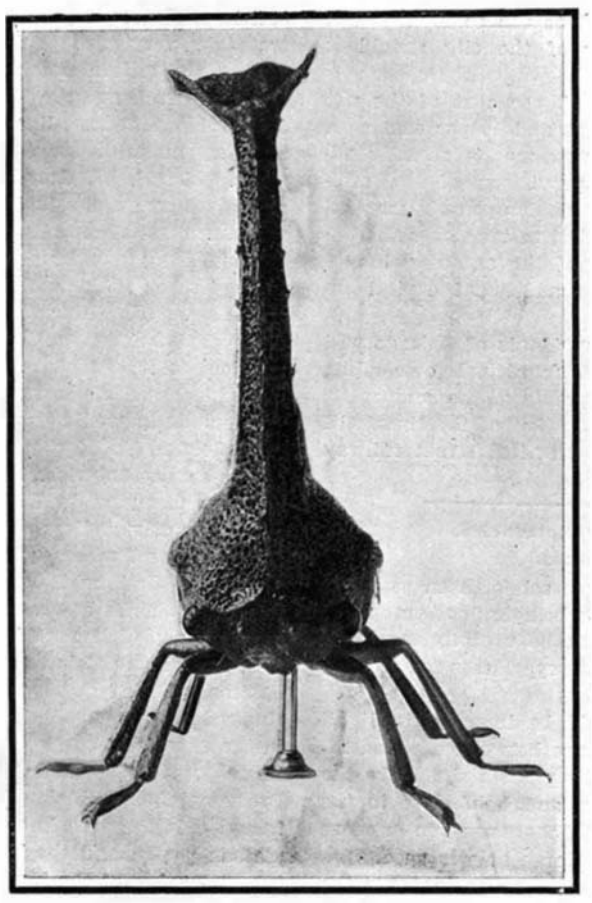


A Peculiar, Brilliant, Yellow Specimen from Brazil.

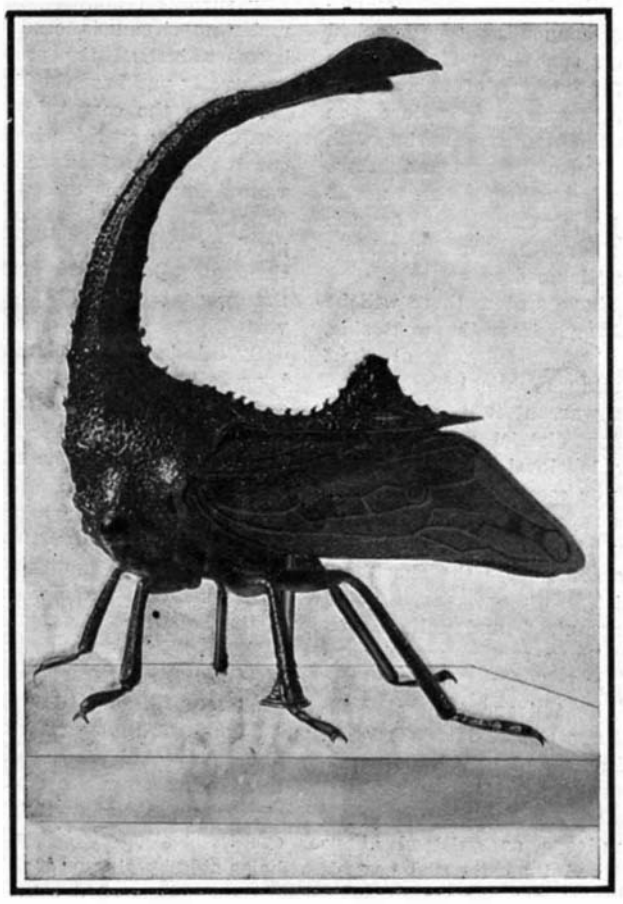
The importance of rectifying all of these evils is apparent not only to the railroads, steamship companies, and the merchants, but to the individual who may have no interest in any large concern. The congested condition of the freight traffic affects his cost of living, and the congested condition of the passenger traffic makes life a burden in riding from his place of business to his home. It affects the price of real estate, and thus produces high rentals. It makes every part of life in the city costly and unpleasant.

The remedy is being partly applied to-day by the railroads, city departments, and officials charged with this important work; but the undoing of the mischief of decades cannot be accomplished within a few short years. It will take the railroads several years to catch up with the traffic. Then, if there is another period of stagnation and inadequate provision for the future, the conditions will steadily grow worse. Not only must the present vast improvements in increasing terminal facilities be completed as shortly as possible, but new plans for the near future must be mapped out continually. In other words, if the city continues to grow at the present rate, an annual investment of millions for the next fifty years will be required simply to enlarge and improve tunnels and railroad terminals. The city will repay this generously in the increased traffic and by a satisfied spirit of its people. Travel must continue to increase instead of diminish unless railroad conditions become intolerable. Then people will elect to stay at home, and the railroads will lose just that much.

It is difficult to obtain correct figures on the total savings that can be effected in the production of iron by the application of gas power, but from 50 cents to $1 per ton of pig iron made has been recorded in various European works. In central electric stations which are located where no energy is available from near-by iron smelting plants or coal mines, the gas producer takes the place of the blast furnace and coke oven as the potential source of energy. Especially is the production of electric power at reasonable rates of importance for very large cities where the price of real estate in the centers of districts is high, and for isolated communities, country houses, and farms which are located outside the commercial radius of metropolitan or other central stations. The distribution of town gas for individual power purposes, while not so much restricted to central location within the city cannot, without loss, be extended over wide territories. Moreover, at the present price of illuminating gas, it cannot compete in the field of power production with the independent suction gas plant even if the latter use anthracite and coke.



Front View of an Insect from Sikim, India.



Side View of the Insect from Sikim, India.

EXTRAORDINARY INSECT ENLARGEMENTS.

How Chicago is Solving Municipal Ownership of Transportation Facilities.

BY A. FREDERICK COLLINS.

Chicago is the second city in the Union, yet for the past decade it has had the most abominable transportation facilities of any city in the United States. This untoward condition is chiefly due to the fact that the principal franchises under which the various street railway companies operate have expired, and the city, heeding the cry of the radicals for municipal ownership, would not renew their corporate privileges. Hence, under these unstable circumstances, the corporations could not see their way clear to rehabilitate their run-down lines.

The problem of serving the population of Chicago has always been an aggravating one, for the transportation system has been necessarily laid out and developed on what is termed the "radiating plan," since the city embraces a territory having on one side a water front. In this respect it is not unlike St. Louis, Boston, and Brooklyn. The shore line of Chicago is, however, much longer than that of the cities just cited, being about 26 miles, while the limits extend inward for a distance of 10 miles. This great area is divided by the confluence of the two branches of the Chicago River into three portions, commonly known as the north, south, and west sides, with the heart of the business district on the extreme northern part of the south side. To this center all the various lines converge. This segregation of the city has resulted in numerous lines operated by a number of companies; so that Chicago, from its transportation viewpoint as well as in some other things, is really to be regarded as three cities instead of one, and as a consequence a passenger often finds that he cannot be carried over the most direct route between the two points within the city limits for a single fare.

The traction question has been a political foot-ball for many years; the citizens and the companies here looked askance at each other, and municipal ownership seemed to many to be the only hope; while the more conservative believed there were other and better solutions of the problem.

This, in brief, was the status of affairs when the city council employed Bion J. Arnold, the noted electrical engineer, as the man best suited for impartially investigating the situation and recommending measures for relief. Mr. Arnold was engaged to procure information and to furnish estimates and opinions relating to the cost of operation and the earnings of the companies, their capitalization, their valuation and cost, together with estimates of a new system, and all other details of a scientific and financial nature.

Among the most important recommendations proposed by Mr. Arnold were the "one-city-one-fare" proposal, with all divisional lines as far as possible obliterated; so that a passenger could be carried over the most direct route between two points for a single fare. Of the three plans submitted, the best one, though not the easiest to execute, contemplated the complete unification of ownership and management. The through route principle was strongly advocated, which means that routes through the business district should be substituted for down-town terminals, wherever possible, while outside the business district better results would follow by connecting the detached lines and operating cars over such lines from end to end. The scheme includes a system of subways to accommodate the street-car traffic and relieve the street surface congestion in the business district, with galleries for the accommodation of present and future underground utilities. The plan calls for three north-and-south subways from Fourteenth Street on the south to Indiana Street on the north. These are high-level subways throughout, with no dips.

In combination with the above system there will be three or more low-level subways from the west side, passing under the north-and-south subways at right angles to them, and extending to Michigan Avenue. Should future developments warrant it, these may be extended under the Lake Front district, now known as Grant Park. These latter low-level subways would require the use of elevators or escalators. Under this plan there will be a surface system and eventually a subway system connecting all the depots and the entire system designed to accommodate the short-haul traffic in the business district.

This plan for a new, reorganized, and unified combined surface and street railway system would comprise the lines of the City Railway Company, the Union Traction Company, the Chicago General Railway Company, and the Chicago Consolidated Traction Company within the city limits and new lines necessary to properly connect the disconnected parts of the system.

The total single-track mileage as outlined above would be about 745 miles, and its estimated cost, if constructed new, with everything first-class throughout, but exclusive of the subways, would be $70,000,000; adding $20,000,000 for the cost of the subways would make the total cost of the new system complete $90,000,000. Under the low-level subways will be the freight subway, while above the street surface will run the elevated lines, making, in all, five lines superimposed at various street intersections. Altogether, it will form the most comprehensive city railway system in the world.

Mr. Arnold's plans further provide for the utilization of the present river tunnels as parts of the future subway system. At the time these plans were submitted, cable power was employed, but on his recommendation the cable systems were changed to overhead electric systems which are now in service. He stated that the electric underground conduit system, such as is installed in New York city, is practicable and feasible from an engineering point of view and that the overhead trolley construction should eventually be prohibited in congested districts, but that outside of these districts the objections are entirely of an æsthetic nature and it is for the city authorities to say—after balancing the financial against the æsthetic considerations—how much, if any, underground conduit construction should be required.

Although at first hostile to the proposed improvements, the traction companies have since admitted the correctness of the conclusions, and these have been adopted and form the basis of the principal physical elements entering into the ordinances recently passed in Chicago. The principles above laid down were ratified by a 33,000 majority of the citizens of Chicago on a referendum vote of the entire city.

The financial provisions of these ordinances are precisely the same as they would be if the city of Chicago should purchase the entire property of the companies, undertake its reconstruction and rehabilitation, and then lease the lines for private operation, upon a division of the net receipts with the lessee company. These ordinances in fact give the people of Chicago to-day, in all the essential principles, municipal ownership of the city's street railways, and their operation by a lessee company, without saddling the burden upon the city of raising the money necessary for the purchase, and without the possibility of any effect upon the financial credit of the city.

To protect the city's share of the net receipts under its agreements with the companies, and to absolutely assure the maintenance of the properties at the highest point of efficiency, the ordinances contain certain provisions never before included in any public utility grant, which are amply sufficient to protect to the fullest extent the city's interest.

For instance, a commission has been appointed in which three engineers are appointed, one by the city, one by the railway companies, and the third being Mr. Arnold, who is the chairman, and represents the city and the companies jointly. This commission has general supervision of all the principal street railway lines in the city of Chicago.

Other provisions of the ordinances are: that the city should have 55 per cent of the net profits of the companies; that there must be daily deposits of the gross receipts to be used for the payment of maintenance and repairs, and a separate special fund of 8 per cent of the gross receipts for renewals and depreciation; and that the companies must supply whatever additional money may be required for these purposes. Any surplus remaining in either of these funds can, under no circumstances, revert to the companies, but becomes instead the property of the city should it eventually purchase the lines.

In turn the companies get 45 per cent of the net profits, 5 per cent for brokerage and 10 per cent as a construction profit upon the new money actually advanced by them under the provisions of the ordinances. The city is given the right, upon six months' previous notice to the companies, to take over the entire properties upon payment of the agreed value of the present property and the additional capital invested.

By this ingenious plan the residents of Chicago will have all the advantages of municipal ownership, secure 55 per cent of the net profits of the companies, and, at the same time, the operation of the lines will be under the management of practical street railway men.

A Substitute for Spectacles.

BY E. M. DOUGLAS.

The use of a pinhole lens was set forth on page 270 of the SCIENTIFIC AMERICAN for bringing out an optical illusion. The same device can be usefully employed by elderly persons dependent on eyeglasses for reading ordinary print.

The print to be read should be in a bright light, and can be held at any distance between one and fifteen inches from the eye. The pinhole should be the size of an ordinary toilet pin and held close to the eye, the best effects being lost if there are two or more holes side by side or if a very large hole is used.

By fitting a card over the nose so as to cover the eyes, with a pinhole opposite each, both can be used at the same time, but with some difficulty and without apparent benefit.

It would be well for every one to remember this simple device, so that when temporarily deprived of glasses reading may not be entirely impossible.

The Three Brazilian "Dreadnoughts."

Contracts have been placed with British naval shipbuilders for the construction of three war-clads for the Brazilian government which though of the same size as the "Dreadnought," will eclipse that vessel in effective gun power. A short time ago Messrs. Vickers, Sons & Maxim received an order from this South American government for the construction of a battleship, but the construction of this vessel has been superseded by one of the three above mentioned. The vessel will be 500 feet in length by 82 feet beam, and will be armed with ten 12-inch guns, several weapons of smaller caliber, together with quick-firers and submerged torpedo tubes. The protective armor is to be of an unusually heavy description. Several new departures in warship design are to be adopted, the most important of which will concern the disposition of the main armament so that the whole of the ten 12-inch guns can be brought to bear on either broadside at one time. In the case of the "Dreadnought" only eight of the ten guns of this caliber can be fired on either side. In the Brazilian warships the heavy guns are to be placed at different levels. They will be mounted in pairs in strongly armored turrets, those fore and aft being at a lower level than those mounted on the center line. The distribution of the gun power, however, is such that absolute balancing will be insured, the guns discharged from the starboard side over the port quarter counteracting the effect produced on the vessel due to the guns rebounding on the port side after firing. This arrangement necessarily entails several modifications of design in order to obtain the requisite stability, while the structural work will be of great strength. The departure, however, marks an important step in the general war-clad design and will contribute materially to the destructive powers of the ship, the broadside firing efficiency being increased thereby by no less than 25 per cent.

The Closure of the Colorado River.

The United States Weather Bureau has sent to Yuma, Ariz., Frank H. Bigelow, a meteorologist connected with the Weather Bureau, and C. E. Grunsky, of the Reclamation Service, for the purpose of conducting a series of elaborate tests in the Salton Sea. With the final closure of the Colorado River, the great Salton Sink, which was inundated as the result of a poorly-constructed headgate of an irrigation canal, and rapidly converted into an inland sea, will gradually dry up. Inasmuch as there are practically no outlets for this vast body of water, the Sink must naturally evaporate to dryness. It is for the purpose of ascertaining the rate of this evaporation that the government officials have been sent to Yuma. Such tests will be valuable because they will give definite evaporation data, which will be of considerable value in the Reclamation Service. According to one opinion, the Salton Sea will dry up in about eight years.

The Current Supplement.

The current SUPPLEMENT, No. 1638, opens with an article on domestic pottery and its manufacture, illustrated by very good photographs. William Maver describes the silicon detector and the measurement of electric wave energy. There seems to be a general impression that sand-lime brick is a new and untried building material scarcely out of the experimental stage. Mr. E. W. Smythe removes that impression, and gives many a valuable bit of information on the structural use of sand-lime brick. The Boyd automatic tide signaling apparatus, which is used at the entrance to the harbor of the Scotch port of Irvine, is described and illustrated. After a ten years' test of cement cylinder piers at San Francisco by the State Harbor Commission, it is accepted that that form of dock construction has come to stay, and that in all probability no stone docks would ever be built on the Pacific ports. Prof. Johann Koenigsberger writes on the temperature of the earth's interior. Some properties of vanadium steel are discussed by E. F. Lake. He tells how small quantities of vanadium affect different mixtures of iron and steel, and when vanadium is most useful. Prof. Alexander Graham Bell writes on aerial locomotion, with a few notes of progress in the construction of an aerodrome. "Schools of Airship Instruction in Germany and France" is the title of an article which will be read with interest by aeronauts. Joel A. Allen concludes his paper on the influence of physical conditions in the genesis of species. Another biological article of value is that entitled "Parasitism and Mutualism." In the opinion of Harlan I. Smith the territory roughly included in the area known as the "Great Plains," the plateau region and the barren lands which form such a vast portion of the North American continent, offers an extensive field for co-operative archeological research, since its prehistoric ethnology is practically unknown. He discusses the chances of this region in an interesting article.

Correspondence.

A Cause of Gun Erosion.

To the Editor of the SCIENTIFIC AMERICAN:

I have read your articles and the communications of your correspondents on gun erosion with a great deal of interest. A part of this trouble may be due to the manner employed in igniting the charge. The spark is applied to the powder near the breech. The expanding gases push forward the unburnt powder and the projectile, forcing some of the former between the latter and the gun barrel, where it explodes, causing a lateral pressure on the barrel, thus further opening up space and retarding the flight of the projectile. If now the powder be first burnt just back of the projectile, then this would move forward alone and the unignited explosive would be pushed toward the breech, where when burnt it would exert its force against the shot. It would cost little to try this, as the ammunition could be easily altered, and might to some extent reduce the erosive effect of the charge.

Dubuque, Ia., May 8, 1907. HENRY B. GNIFFKE.

A Way of Cleaning Silver.

To the Editor of the SCIENTIFIC AMERICAN:

I know of rather a unique way to clean silver that I think may interest some of the readers of SCIENTIFIC AMERICAN. Some time ago a powder was put on the market under a trade name that cleaned silver remarkably easy. It sold for twenty-five cents a quarter pound. Upon analysis, carbonate of soda (Na_2CO_3) or washing soda was the only ingredient found.

Take a large tin pail and fill it with a hot solution of carbonate of soda and water, one tablespoonful of soda to the quart of water. Take any silver article and stir it around in the solution, but do not touch the tin pail with it. If in a minute or so it is taken out no change will be seen. Now immerse it again and touch the bottom of the tin pail with the article to be cleaned, and upon taking it out of the solution it will be found to be cleaned and polished. Rinse in hot soap suds and wipe dry; if this is not done the article will turn yellow.

I should be pleased if the SCIENTIFIC AMERICAN or some of its readers will tell me the action that takes place when the silver and tin come in contact with each other. LESTER D. WISE, M.D.

New York, April 24, 1907.

Remodeling Battleships.

To the Editor of the SCIENTIFIC AMERICAN:

Would it not be possible to remodel the "Georgia" class of battleships so as to bring them up to the highest plane of "all-big-gun" ships? I have devoted some time to the "Connecticut" class, and find that by a trifling addition to weight, guns, and gun protection the following change could be made—open, however, to the disadvantage of restricted arc of fire of the proposed 10-inch guns.

Enlarge the present 8-inch turrets slightly, and replace the 8-inch guns with 10-inch guns. Substitute 5-inch guns in broadside for the present 7-inch. The weight thus saved would almost compensate for the added weight of 10-inch guns. If feasible, this class would have but little fear from the "Satsuma" class. Thus:

"Connecticut."	"Satsuma."
16,000 tons, 18.5 knots.	19,000 tons, 21 knots.
4 12-inch.	4 12-inch.
8 10-inch.	12 10-inch.
12 5-inch.	20 4.7-inch.

As I understand the "Satsuma" battery arrangement, she can bring but four 12- and six 10-inch guns to bear. The "Connecticut" would thus be outmatched by two 10-inch guns only, and probably 2 or 2.5 knots in speed—quite a handicap, but not necessarily fatal.

If this arrangement of weights would be too "top-heavy," the alternative of removing the 8-inch guns and substituting a single 10-inch gun in a somewhat elliptical turret, with really less weight than at present might be attempted, leaving her thus:

"Connecticut."	"Kashima."
16,000 tons, 18.5 knots.	16,400 tons, 18 knots.
4 12-inch.	4 12-inch.
4 10-inch.	4 10-inch.
12 7-inch.	12 6-inch.

This would permit the "Connecticut" to answer gun for gun, opposing the 6-inch guns on the "Kashima" with her own 7-inch guns.

If the first suggestion were carried out in three, and the second in two of this class, which are practically in commission, I feel sure the remaining ships could take care of the rest.

Figuring out the "Georgia" plan, I find that the "Georgia" class can, with practically the present weights, carry this battery:

8 12-inch		4 12-inch.
12 5-inch	instead of	8 8-inch.
		12 6-inch.

As the "Dreadnought" carries 12-inch guns in turrets about as widely separated as the two proposed to take the place of 8-inch turrets abeam, I see no difficulty except the possible cutting away of the superstructure to make room for the larger turret.

San Francisco. S. O. BLODGETT.

Outline of an Aerial Contest for the Scientific American Cup.

To the Editor of the SCIENTIFIC AMERICAN:

I note your generous encouragement given to aerial flight by the offer of a prize. It is a subject to which I have given much attention and I would respectfully put forward my views as to what the nature of a test of an aerial machine should be.

All the experimenters seem to be possessed of one idea only, and that is to fly forward in a horizontal straight line and by means of planes to sustain the machine above earth.

A machine may fly for a long distance in a straight line and yet be a total failure as a flying machine.

If its safety depended upon keeping up a certain speed in a straight line, as all aeroplane machines do, then I submit that they are not flying machines; a stoppage of the engine or its slowing down would mean annihilation.

To sail a machine from a tower or top of a hill to the bottom is a foolish experiment. Any flying machine worthy of the name must sail from the ground upward to the top of a hill or tower. The old parachute will sail safely with a man aboard from the top of a tower to the ground, but it is not a flying machine; it cannot sail up again. Of how much use would a steamship be, even if it could go from here to New York in a straight line, if it would promptly go to the bottom of the sea if the engine stopped or slowed down? That is what would happen to the aerial machine on aeroplane principles.

I would submit that there are three essential tests to be applied to any machine which claims to be a flying machine:

First, it should be able to rise of its own power from the ground level, and soar to a few hundred feet height; second, it should be able to hover over any spot on the earth for any time desirable without any straight-line movement; third, it should come down to earth safely from any height when the engines are stopped.

From my point of view we should first meet these requirements before even beginning to think about straight-line flight.

Any one of these three requirements is worth a hundred times more than a hundred-mile straight-line flight. They are absolutely essential in anything which could seriously be considered a flying machine.

The aeroplane I have studied long but have come to the conclusion that no successful flying machine will depend in any way upon aeroplanes for sustaining them in the air, and the results of all the recorded experiments with them amply confirm me in that conclusion. An aeroplane has no propelling or sustaining power in itself. The prime mover and the propeller on a flying machine alone must supply all the power required for sustaining the weights and propulsion.

The work, then, had better be done direct, by engine and propeller, and then aeroplanes become only uselessly added weight and resistance, with no reason for their existence at all. Aeroplanes may be useful for balancing and steering purposes, but never for the two prime functions, propelling and supporting the weight.

To encourage the solution of the problems on the right lines, a prize for a machine which would go up, stay up for a time, and come safely down, it seems to me would bring the matter into the realm of engineering. RANKIN KENNEDY.

Glasgow, May 4, 1907.

THE NEW WHITE STAR LINER "ADRIATIC."

BY OUR LONDON CORRESPONDENT.

On May 16 there arrived at New York on her maiden trip the latest acquisition to the transatlantic fleet of the White Star Line, the "Adriatic." This vessel, constructed at the Belfast shipyards of Harland & Wolff, constitutes a new record in shipbuilding construction; and she is the largest vessel that has ever entered this port. She measures 725 feet 9 inches in length, with 75 feet 6 inches beam, and is 50 feet deep, her gross tonnage being nearly 25,000 tons and displacement 40,000 tons. Of the five largest and heaviest liners at present engaged in service between America and Europe, no less than four fly the White Star flag. They are as follows:

"Adriatic"	25,000 tons.
"Baltic"	23,876 tons.
"Amerika" (German)	23,000 tons.
"Cedric"	21,000 tons.
"Celtic"	20,904 tons.

The "Adriatic," it will be observed, exceeds the tonnage of the "Baltic" by 1,124 tons. In this liner the same policy is maintained by the White Star Company as in the case of the "Oceanic." Speed is, to a certain extent, sacrificed to comfort, while at the same time the vessel is given a larger cargo-carrying capacity. Upon the "Adriatic" many important innovations have been introduced for the purpose of relieving the traveler of any feelings of ennui. The decoration of the vessel is carried out upon more luxurious and sumptuous lines than have been attempted in any other vessel of the same class.

In seaworthiness and stability, it is anticipated that this liner will show a decided advance even upon its most recent prototypes. The ship is very strongly framed, divided into twelve water-tight compartments, and has a double bottom extending through the entire length of the hull. The total number of plates used in its construction aggregates approximately 20,000, while two and a half million rivets were used. The anchors, weighing about 8 tons each, are worked by powerful gear, the cables being 3⅜ inches in diameter and weighing 90 tons. There has been a careful consideration of the distribution of weights; so that easy steaming may be possible in any kind of seaway. The vessel is propelled by two sets of quadruple-expansion engines, driving twin screws.

With regard to the internal arrangements, a greater degree of roominess has been obtained. An unusual amount of headroom has been provided, while great width has been given to the upper series of the nine decks used by passengers. There is the continuous shade deck running fore and aft, with three tiers of deck houses, and three promenade decks alongside them. The staterooms are lofty, well lighted, and excellently ventilated, these arrangements being appreciably facilitated in design by the great beam of the vessel and the exceptional height between the decks.

In regard to the first-class accommodation, the "Adriatic," in response to the growing demand, has an unusual number of single-berth rooms, there being no less than seventy-six of these apartments. The appointments throughout are of the most sumptuous character, many little novelties and conveniences being freely introduced to dispel the feeling of being afloat as much as possible. The dining saloon is on the upper deck, and extends the full width of the vessel, and the situation has enabled an exceptionally airy and roomy apartment to be provided, with seating accommodation for some 400 persons. The style of decoration and furnishing is Jacobean, the general tone being ivory white, which is now so much the vogue in Europe. The illumination is obtained from a large dome, glazed with leaded glass in white and pale yellow tones, beneath which is a frieze of paintings representing scenes in Switzerland, Italy, the Yellowstone Park, and in various countries. The seating arrangements follow the lines of separate tables, adopted a little while ago with conspicuous success.

The reading and writing saloon is on the boat deck. The scheme of decoration is of a delicate character, comprising paneling and ornamentation in low relief, the panels being filled with paintings of the graceful and imaginative school, as represented by Bartolozzi, Cipriani, and others. The windows are of large size, filled with stained leaded glass, the furniture being birch richly inlaid. The electric illumination is carried out by shaded ceiling and wall lights, giving a soft, restful effect. The lounge is on the same deck, and is paneled in oak with an appropriate ceiling to match. The same scheme as regards windows is followed, the stained glass carrying figures of illustrious poets, painters, dramatists, and philosophers. The smoking saloon is of a somewhat heavier appearance, the walls being embellished with figured leather, the upholstery of the furniture to match the prevailing color being a rich mahogany hue.

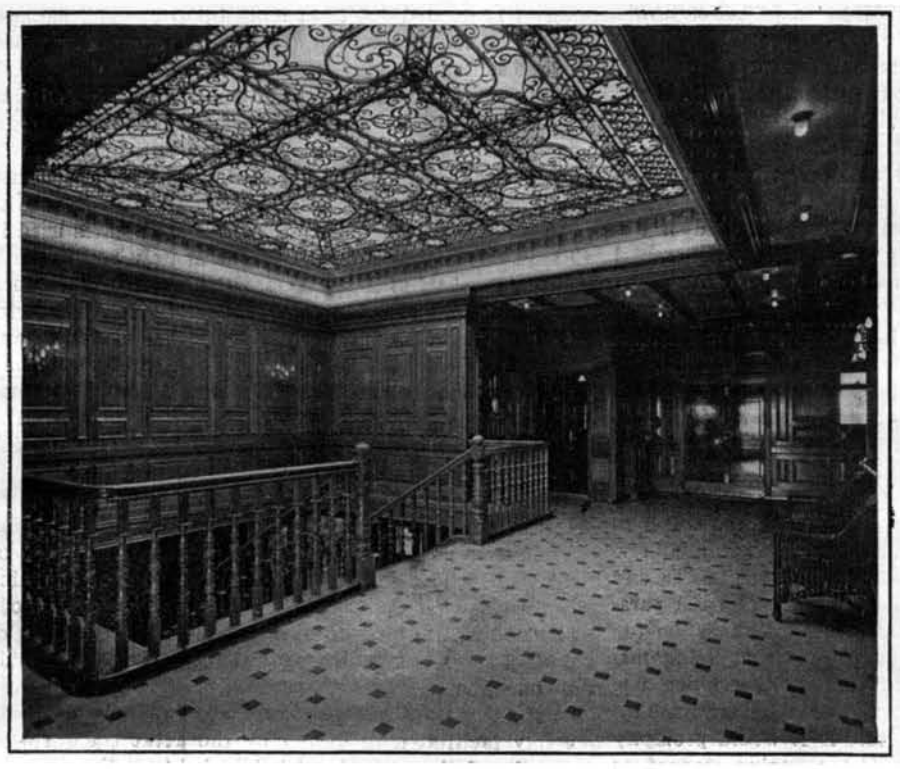
Many important innovations, which will be greatly appreciated, have been introduced for the convenience of the first-class passengers. Communication between the various decks is facilitated by an electric lift; a feature first suggested to the Cunard Company by a member of the editorial staff of the SCIENTIFIC AMERICAN. Another new feature is a large gymnasium, fitted with an ample variety of apparatus. Turkish baths consisting of the usual hot, temperate, and cooling rooms, with plunge bath, massage couches, and shampooing rooms, are also provided, while the conveniences in this direction are further supplemented by three electric baths. Photographers have a dark-room placed at their disposal, and there is an inquiry office, at which every kind of touring information desired by the traveler can be gained.

The second-class accommodation is immediately abaft that provided for the first-class passengers, and consists of dining saloon, smoke room, and drawing room for ladies. The staterooms are decorated in white paneling; the smoke room is framed in oak, with walnut dado, the furniture being in harmony with leather upholstery. The ladies' room is in satinwood embellished with inlaid panels, with mahogany furniture and dado lincrusta ceiling, parquetry flooring and stained-glass windows. The dining saloon

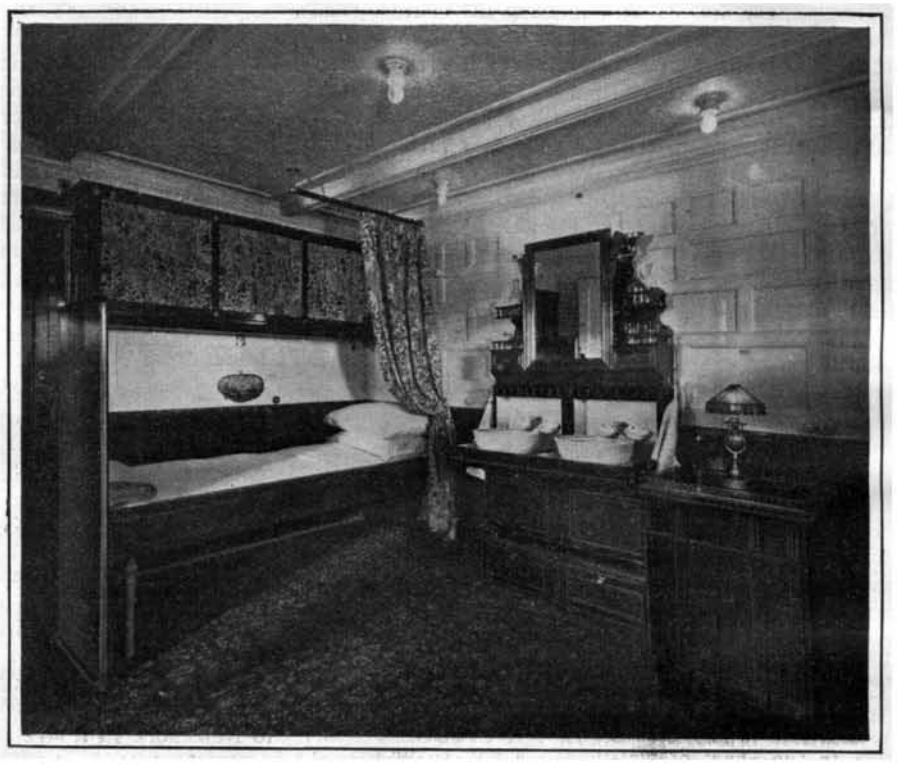
also extends the full width of the ship, and is finished in white and gold. By placing the second-class quarters on the same level as the first-class, the same advantages as regards loftiness, spaciousness, ventilation, and lighting have been insured.

The third-class quarters are abaft the second-class, and to a certain extent in the fore part as well. Here spacious dining, smoking, and sitting apartments are provided, finished in white framing and teak dado, while a great space is available in the large open 'tween decks, clear of all obstructions, for exercise and recreation.

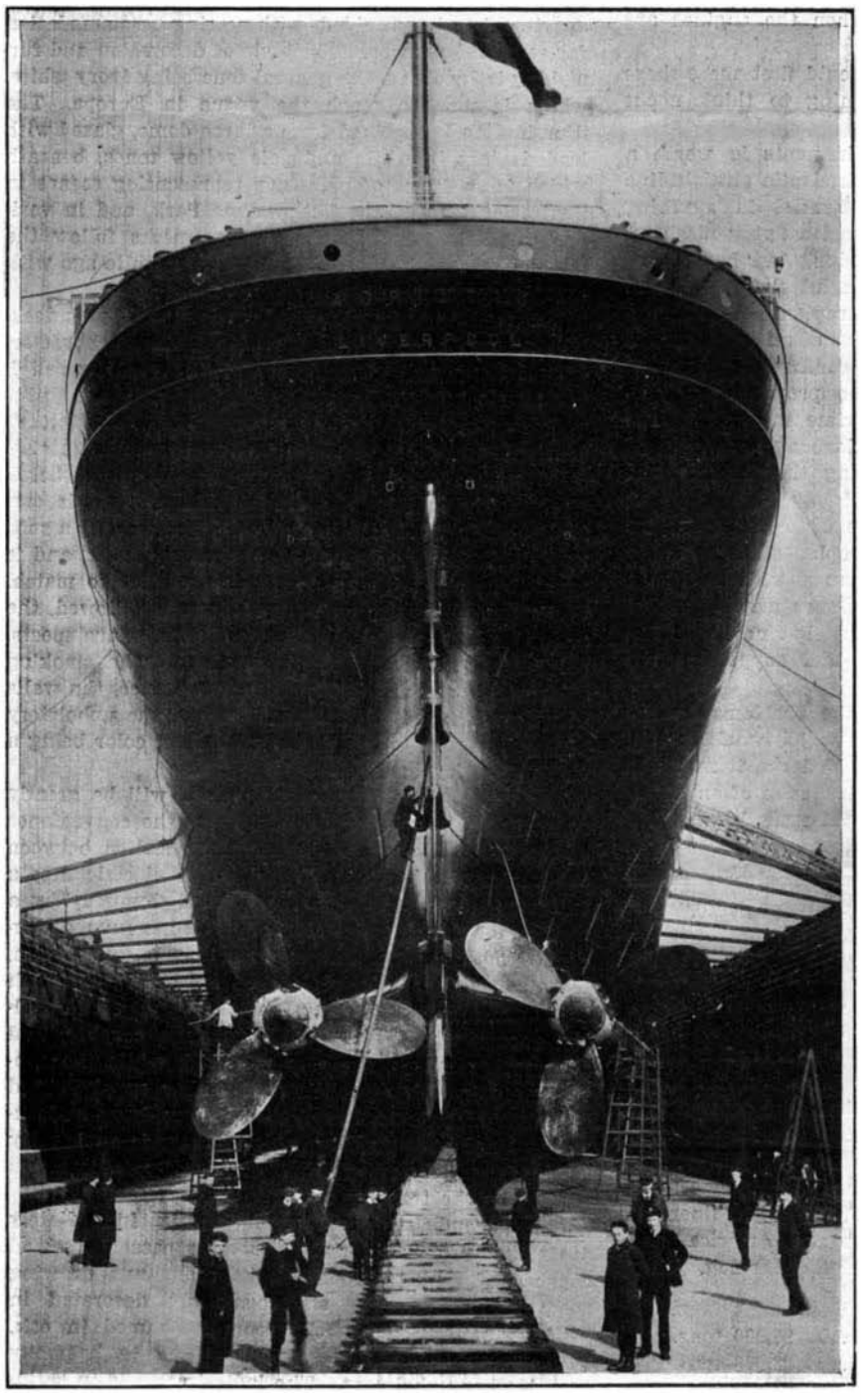
The vessel is equipped with large storerooms and refrigerating chambers for the carriage of provisions. The immense tonnage of the ship gives a very large cargo-carrying capacity, the loading and discharging arrangements for which are of the latest and most efficient type. Noiseless and rapid-working electric winches are installed for handling baggage and stores. On the boat deck aft is the Marconi station, while the ship is also equipped with submarine signaling apparatus. As already mentioned, the "Adriatic," in common with the other ships of this line, has not been built for speed, the voyage occupying some eight days between the two continents; but in regard to luxury and comfort in travel, she represents the latest expression of the shipbuilder's craft.



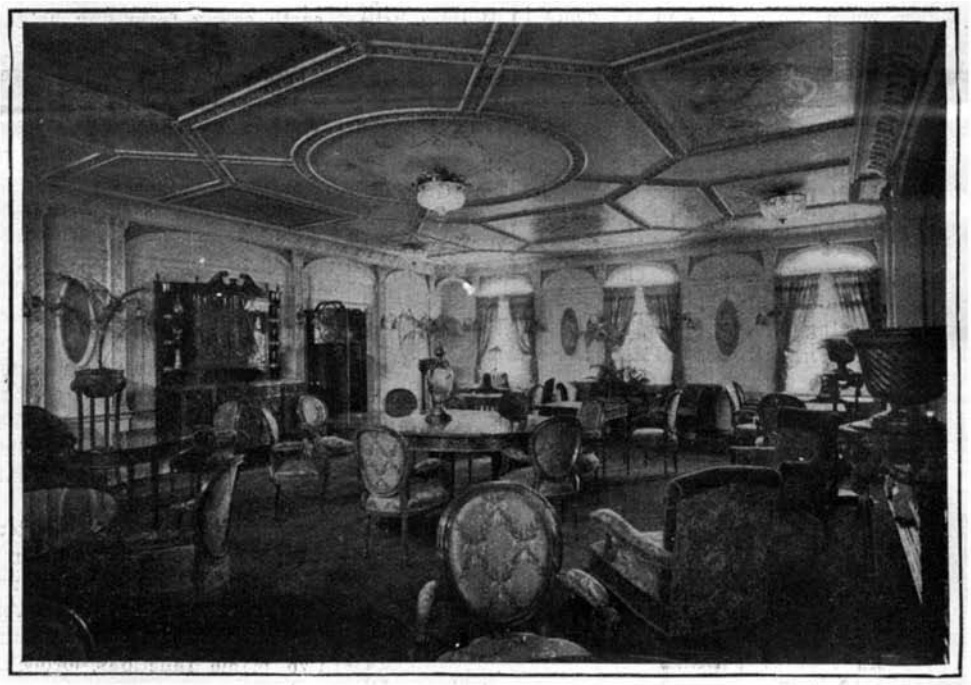
One of the Landings of the Main Stairway.



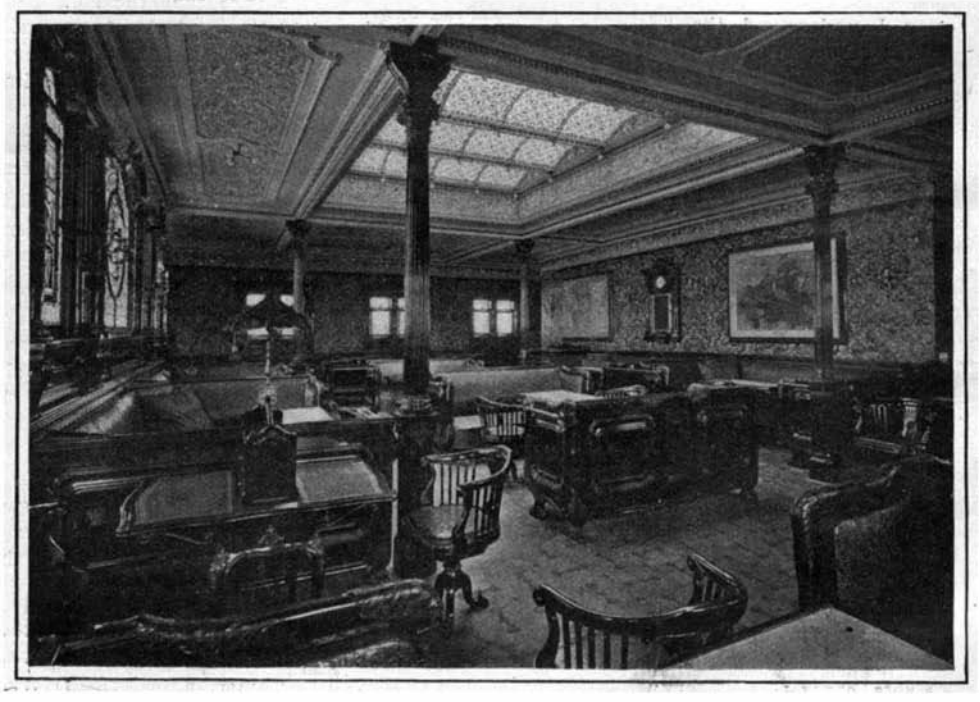
Typical First-Class, Single-Berth Stateroom.



Stern View, Showing Great Depth of the Plated Structure of the "Adriatic."



The Writing Room.

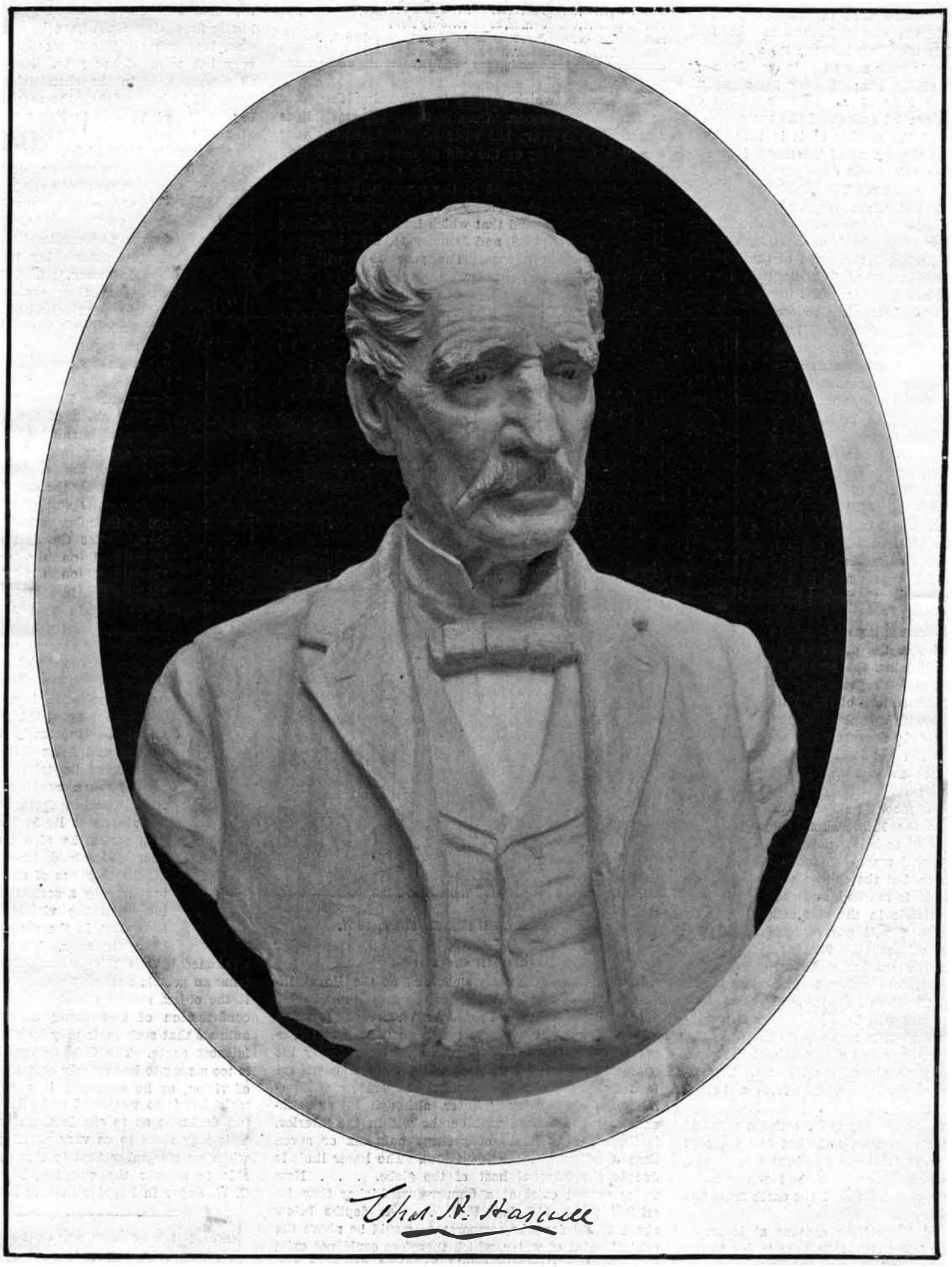


The Smoking Room.

THE WHITE STAR LINER "ADRIATIC"—THE LARGEST SHIP AFLOAT.

CHARLES HAYNES HASWELL.

By the death of Charles Haynes Haswell, New York city has lost one of its oldest, best-known, and most esteemed citizens, and the engineering world one of the most distinguished members of the profession. It is not often that the scope of a man's genius is matched by the term of his years of life in so generous a measure as in the case of Mr. Haswell, who was not only endowed with an uncommon share of the mental and physical qualifications which are necessary to the make-up of a successful practical engineer, but who continued in the prosecution of his work, uninterruptedly, for over three-quarters of a century. Time laid its hand gently upon this veteran, and on the occasion of his last visit to this office, a few weeks before his death, his erect carriage and brisk, almost jaunty, step gave little indication that he bore upon his shoulders the burden of close upon a century of years.



Mr. Haswell was essentially a New Yorker. Born May 22, 1809, in North Moore Street, he was identified with this city by the ties of residence, active professional life, and strong affection. After completing his education, and at the age of nineteen, he commenced his professional life in the boiler works of James P. Allaire, the well-known iron-master. It was at this time that he took a step, which was destined both to bring honor to himself and place at the disposal of one of the government departments the services of one of the ablest engineers of the time. In the year 1835 he offered his services to the Navy Department in a letter which is of such timely interest that we give it in full:

NEW YORK,
Jan. 12, 1835.

Sir: Understanding that our government are about making experiments with steam and the steam engine, for the purpose of ascertaining the practicability of their application for naval purposes, it has induced me to address you, requesting such information on the subject (as your leisure and inclination will warrant your attention to it) both as respects the manner in which the proposed inquiries are to be made, and the objects desired to be accomplished. My object is the tender of my services as a steam engineer and draftsman, being particularly anxious to pursue my profession in the employ of the government. Yours very respectfully,

CHARLES H. HASWELL.

To Hon. Campbell P. White,
Chairman Comm. on Naval Affairs.

Mr. Haswell's services were accepted, and he was enrolled as a naval engineer in the year 1836. His promotion was speedy, and after some years duty as Chief Engineer, the formal title of Engineer-in-Chief was conferred upon him in the year 1845. He was the first to obtain this rank, which he held until the year 1851. His work during this period included the designing of the complete machinery for ten warships, in which was embodied several of his own original mechanical improvements.

Mr. Haswell was a man of fearlessness and independence of character, particularly where his professional convictions were concerned, and when the absurd proposal was made to build the "Missouri" with horizontal smokestack, the young engineer opposed the proposition with such zeal as to cause his suspension. The failure of the ship, which he had predicted, so greatly enhanced his professional reputation, that his reinstatement was promised if he would apologize to his superior officer—a condition which he, with dignity, refused to accept, stating that he would rather submit to injustice from others than do it to himself. Mr. Haswell re-entered the service of the navy, and after his final retirement engaged in engineering practice in New York. For over forty years he was surveyor for steamships for the Marine Underwriters of New York; he designed the buildings on Hoffman Island; built the crib bulkhead at Hart's Island; and solved successfully some of the most difficult early building foundation problems in New York. He was the engineer in charge of the costly improvements now being carried on at Riker's Island, to the oversight of which he devoted much time in recent years. At the time of his death he held the position of Consulting Engineer to the Board of Apportionment, and in spite of his great age he went three times a week to his office for the performance of the duties incidental to this last-named position. Perhaps his earliest claim to distinction was Mr. Haswell's construction of the first steam yacht, for whose designs he was entirely responsible. He launched the craft in the year 1837 on the East River, and it is upon this fact that his right to be known as the father of the steam yacht is based. To the world at large, however, Mr. Haswell's name is most familiar as the author of "Haswell's Pocket-book," which has already passed through no less than sixty editions. It is still a well-known and widely-used technical book of reference. His other work was his "Reminiscences of an Octogenarian," a book of memoirs covering old New York from 1816 to 1860.

On the social side of his character and personality Mr. Haswell was decidedly attractive, and he was beloved by a wide circle of acquaintance. To the very last, his figure was familiar in his favorite resort, the Engineers' Club.

From the very year of its foundation, Mr. Haswell was a frequent visitor at the offices of the SCIENTIFIC AMERICAN, and the friendship formed with its proprietors sixty years ago continued to the very end, Mr. Haswell having expressed the deepest regret at the recent decease of Mr. Orson Desaix Munn. His own death resulted from an accidental fall in his dining room, which dislocated his shoulder. The pain and shock proved too much for a vitality which, in the opinion of his physician, but for the accident would have probably carried him to the century mark.

The American consul at Nankin utters a caution to his fellow-countrymen, who spend lavishly on illustrated catalogues, on thick paper, handsomely bound, which appear to be highly prized by the Chinese at Nankin, where the supply is at times unequal to the demand. As the English language is not yet a general accomplishment among the citizens, the consul made inquiries, and discovered that the leaves of the catalogues were being used as inside soles for shoes.

ECLIPSE OF THE SUN IN JULY, 1907.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

The form of the moon's path in space, which is the resultant of two motions—the earth's revolution round the sun, and that of the moon round the earth—was shown in an article "How Eclipses Occur," published in the SCIENTIFIC AMERICAN for August 11, 1906.

The motion of the moon is so slow in comparison with that of the earth, that each day the earth traverses a distance equal to three and one-third times the diameter of the moon's orbit. As a consequence, the form of the moon's path projected on the plane of the ecliptic is a curve without inflection; i. e., it is always concave toward the sun.

But the moon's path relative to the earth may be studied without reference to its path relative to the sun, for the same reason that the earth's orbit is usually studied without any reference to the fact that the sun itself is traveling through space.

The eclipses for this year are as follows: January 13, a total eclipse of the sun; January 29, a partial eclipse of the moon; July 10, an annular eclipse of the sun; July 24, a partial eclipse of the moon.

As the diameter of the earth's orbit is three hundred and eighty-nine times that of the moon, it is important to emphasize this great difference in a study of solar and lunar eclipses. The diameters of the orbits of the earth and moon are correctly proportioned in Fig. 1; and in order to compare them within the limits of this page, the moon's orbit is represented by the very small circles at the dates of the eclipses of the sun and moon in July. The diameter of the sun, which is about one and four-fifths the diameter of the moon's orbit, is also correctly proportioned in the drawing. Fig. 1 also represents approximately the relative diameters of the sun and moon, which are very nearly in the same proportion as the diameters of the earth's and moon's orbits.

In an examination of the positions of the earth and moon relative to the sun during the eclipse in July, the moon's orbit is shown in Fig. 2 on a scale large enough to make clear the conditions which result in an eclipse. The plane of the moon's orbit is inclined at an angle of a little over five degrees to the plane of the ecliptic. That part of the orbit which is above the plane of the ecliptic is represented by the heavy line; and the part which is below, by the fine line.

The point *N* is the ascending node, where the moon's orbit pierces the plane of the ecliptic. The lines joining the ascending and descending nodes with the center of the earth are the intersections of the plane of the moon's orbit with the plane of the ecliptic. Each line slowly changes its direction while the earth is revolving round the sun, i.e., it does not move into parallel positions.

The position of the moon is shown each day from July 8 to the 13th. From the 8th to the 10th she will be below the plane of the ecliptic, and will reach the ascending node on the 10th, but the eclipse will occur before the node is reached, and consequently will be visible in the southern hemisphere. The moon will pass apogee the day before the eclipse (the 9th) and will be very near her maximum distance from the earth. She will therefore subtend an angle which will differ a very little from its minimum value. The sun's apparent diameter will be a little over two minutes greater than the moon's, notwithstanding that the earth will have recently passed aphelion, and the sun's apparent size reduced to almost a minimum. The result will be an annular eclipse visible from a limited area of the earth's surface.

It is noticeable that the seasons for eclipses recur at intervals of about six months, and that two or more eclipses may follow at intervals of about two weeks, when sufficient time has elapsed for the moon to make about one-half her revolution round the earth from one node to the other.

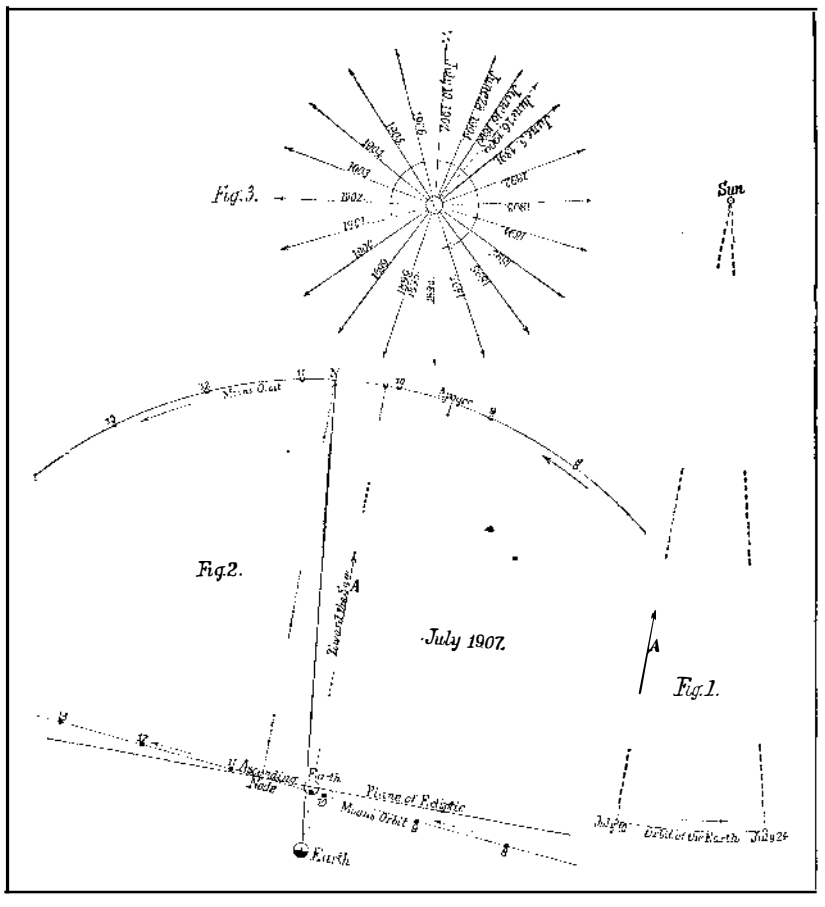
The recurrence of the eclipse seasons at intervals that average a little less than half a year is due to the gradual twisting of the line of nodes. Fig. 3 shows the position of the ascending node at each of the dates attached, from 1890 to 1909, during which period the ascending and descending nodes make a complete revolution in a direction (indicated by the arrow) contrary to the moon's motion in her orbit. The positions of the descending node are omitted to avoid confusion.

One June 16, 1890, the moon passed the ascending node. On that day there was an annular eclipse of the sun. The moon will pass the same node on June 16, 1909. The period of twenty years includes forty-six eclipses of the sun, and thirty of the moon. A lunar appulse occurs three times. The following table gives the dates of eclipses from 1890 to 1909 inclusive, and is arranged to show the effect of the rotation of the line of nodes, which results in advancing the dates of the eclipse seasons. Usually there are two eclipse seasons in the year; but when an eclipse occurs very near the beginning or the end of the year there may be included in that particular year three eclipse seasons. This is illustrated in the years 1898 and 1899. The meaning is obvious. An eclipse season belongs partly to one year and that which immediately follows. December 12, 27, 1898, and January 11, 1899, belong to the same eclipse season. The year 1908 will also include three eclipse seasons.

TABLE.

Eclipses of the Sun and Moon from 1890 to 1909.

1890	June 2, 16	Nov. 25, Dec. 11
1891	May 23, June 6	Nov. 15, 30
1892	Apr. 26, May 11	Oct. 20, Nov. 4
1893	Apr. 15	Oct. 9
1894	Mar. 20, Apr. 5	Sept. 14, 28
1895	Mar. 10, 25	Aug. 20, Sept. 3, 18
1896	Feb. 13, 28	Aug. 8, 22
1897	Feb. 1	July 29
1898	Jan. 7, 21	July 3, 18, Dec. 12, 27
1899	Jan. 11	June 7, 22, Dec. 2, 16
1900		May 28, June 12, Nov. 21
1901		May 3, 17, Oct. 27, Nov. 10
1902		Apr. 8, 22, May 7, Oct. 16, 30
1903		Mar. 28, Apr. 11, Sept. 20, Oct. 6
1904		Mar. 16, Sept. 9
1905		Feb. 19, Mar. 5, Aug. 14, 29
1906		Feb. 8, 22, July 20, Aug. 4, 19
1907		Jan. 13, 29, July 10, 24
1908		Jan. 3, June 28, Dec. 7, 22
1909		June 3, 17, Nov. 26, Dec. 12



ECLIPSE OF THE SUN IN JULY, 1907.

Water in the Earth.

In a discourse recently delivered at the Royal Institution in London, in regard to ore deposits and their distribution and depth, Prof. John W. Gregory presents an astonishing view of the condition of water at temperatures above its critical point. It is evidently his opinion that the elements of water are not combined with each other above the critical temperature of liquefaction, for he says: "Water, although its constituents may come from vast depths within the interior, is limited to a depth of perhaps only six or seven times the depth of existing mines. The lower limit is due to the internal heat of the globe. . . . Now water cannot exist at a temperature higher than its critical point, 687 deg. F. . . . At depths below about 37,000 feet the temperature would be above the critical point of water, which therefore could not exist as such. Its elements would be given forth as separate gases from the slowly cooling magma; the gases would rise, and having passed into a zone with a temperature below the critical would combine to form water." The author has confused the critical temperature of liquefaction, 358 deg. C., with the temperature of dissociation of water, which is probably about 2,500 deg. C. The only change which water undergoes at its critical temperature is the loss of its surface where it is in contact with a gas or vapor, no matter how great the pressure may be. If the view set forth in the quoted extract were true, the maximum temperature to be obtained by the combustion of hydrogen and oxygen would be 687 deg. F., which is near the boiling point of mercury.—Chem. News.

Ancient Lenses.

Contrivances for bringing the rays of the sun to a focus in order to produce combustion have been employed almost from time immemorial. A curious proposal bearing on this point is made by Aristophanes in his comedy of the "Clouds." Strepsiades, the hero of the play, is greatly harrassed with debts and has not the wherewithal to pay. He therefore proposes to his master to get a stone at some chemist's shop of the kind with which they kindle fire, and when the clerk is entering the suit, to stand at some distance and melt it out. As the writing tablets then in use were probably thin boards covered with a still thinner coating of wax on which the writing was done with a pointed instrument, it would not require great heat to effect the purpose. Besides, if, as seems to have been the case and custom, burning-glasses were used to kindle fires, they must have been of considerable size even in a country like Greece, where the sun shines very hot most of the year. Moreover, we are told, they were kept in the chemists' shops for this purpose. If by any mishap the sacred fire watched over by the Vestal Virgins in Rome went out, it was rekindled by means of a burning-glass. Polybius, when speaking of the siege of Syracuse by the Romans, B. C. 214, relates that they were unable to take it from the side of the sea because of the engines employed against them by Archimedes, unquestionably the greatest mechanician of the ancient world. Says he: "So true is it that one man and one intellect properly qualified for the particular undertaking is a host in himself and of wonderful efficacy." The Romans were confident that they could take the city "if one man could be got rid of." He might have added with equal truth that when a man appears in a world wholly unprepared to comprehend him, not only are his thoughts neglected, but his discoveries forgotten. The story that Archimedes set the ships of the Romans on fire by means of burning-glasses is not found in any author who lived near his time. Moreover, the captains of the vessels would hardly be so obliging as to hold their vessels stationary in order that the old philosopher might work his will on them. Yet the marvelous feats he accomplished on the same occasion and vouched for by credible witnesses are scarcely less incredible. It may be accepted as certain that Archimedes produced wonderful effects by means of his lenses, whether they were made of glass or of some other material. That the ancients as late as the age of Plutarch knew nothing of spectacles is clear from the negative testimony of this writer, whose works might be superscribed "Concerning All Things and Some Others." In one of his table talks he tries to explain why old people, when reading, hold the book at some distance from the eyes. He finds the reason to lie in Plato's theory of vision, which he also holds. This philosopher maintained, in common with almost all the thinkers of antiquity, that sight is produced by a sort of fluid substance passing from the visible object to the eye, somewhat in the shape of a cone, the eye being the apex. When the organ becomes weakened by age this attenuated substance is too intense to permit normal vision; so in order to weaken it the object must be held farther away. He finds a confirmation of this theory in the habits of those animals that seek their prey by night when their sight is most acute. The fluid emanating from the object is too strong to be properly commingled with the power of vision, as he expresses it, possessed by these animals, but is so weakened and diluted by the surrounding darkness as to enable them to see at their best. This may seem to us very puerile; it ceases to be so when we remember that to this day no one has been able to answer the question, How do we see?—Dr. C. W. Super in Popular Science Monthly.

Completion of One Tube of the Belmont Tunnel.

Engineers walked through the north tube of the Belmont tunnel on May 16 from Manhattan to Long Island City and then returned to the meeting point of the two shafts to celebrate the nominal completion of one of the most remarkable tunnel engineering jobs on record. Shields of the north bores joined about midway between the Man o' War reef in the middle of the river and Long Island City, the connection being made in solid rock.

The north tube will be ready for trains of the New York and Long Island Railroad Company by August 1.

It will be at least two months, according to St. John Clarke, one of the engineers in charge, before connection will be made in the second or southeast tunnel between the reef and Long Island City.

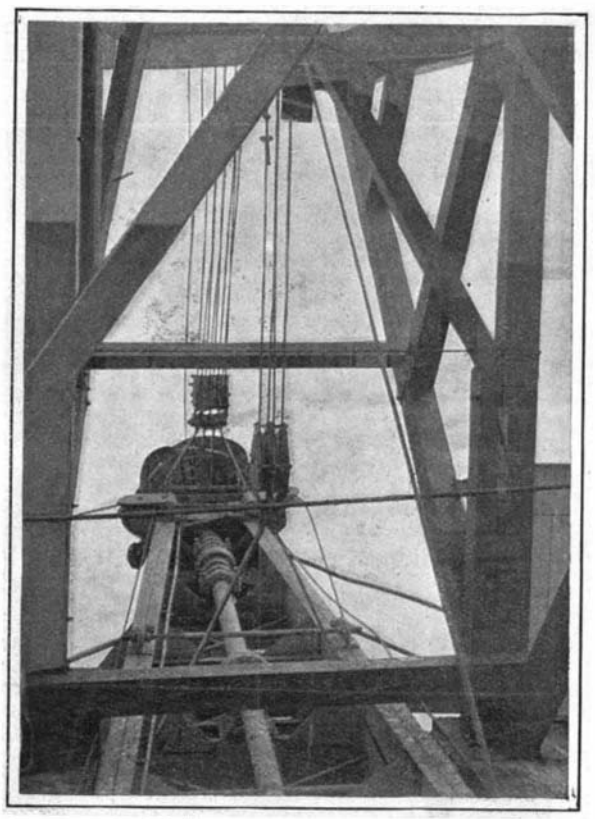
BUILDING A TOWN SITE BY SUCTION DREDGE.

BY RAY ALLEN WILLEY.

In a recent issue of the SCIENTIFIC AMERICAN appeared an interesting description of how the city of Galveston is being rebuilt upon the sand—but sand of such a character that the community can well be said to be upon a solid foundation. The work which is being done in raising Galveston Island farther above the sea level is indeed a noteworthy engineering feat, and is an indication of what can be accomplished by using the modern suction dredge.

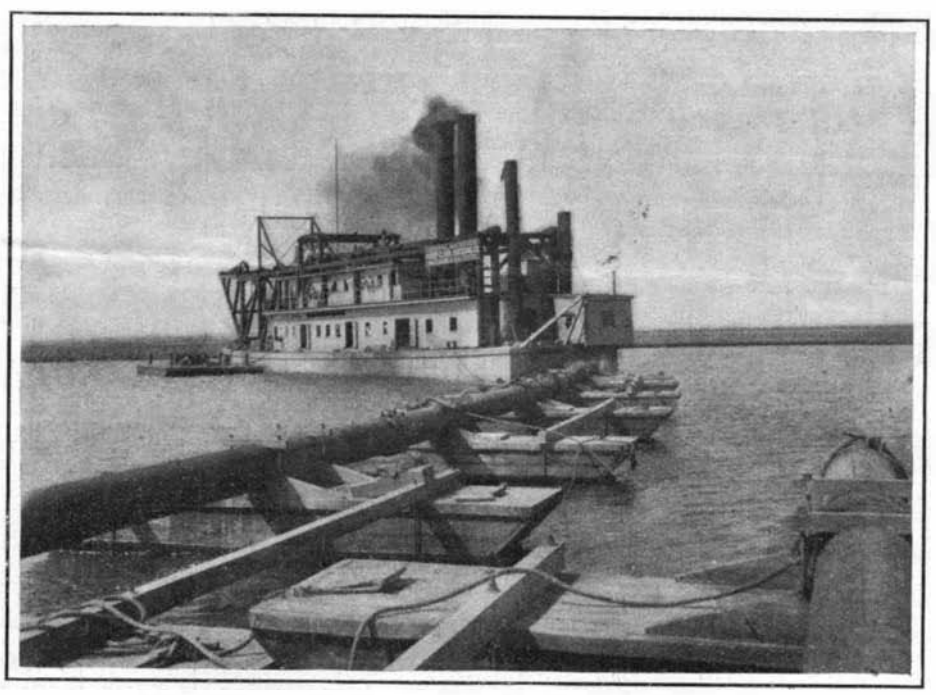
It is an interesting fact, however, that another site for a city is being created on the New Jersey coast—entirely by mechanical methods—which in magnitude rivals the undertaking at Galveston. The town of Cape May, N. J., takes its name from the point which marks the junction of Delaware Bay and the Atlantic Ocean. The community is situated a few miles north of the cape proper on the Atlantic coast. It occupies a portion of a low flat peninsula. From the northern end of Cape May to what is known as Cold Spring Inlet the formation is principally salt meadows, a portion of which is covered with water at high tide, and during storms is frequently completely submerged. With the exception of a row of sand dunes immediately upon the beach, all of this land is but a few feet above the sea level even at low tide. Like other marshes of the same character, it is densely covered with grass and other vegetation, and its formation near the surface is a mixture of loam and clay, which, on account of the action of the water, has become a mud bank covered with slime. This portion of the seacoast has been entirely valueless, and a menace to the public health on account of the gases arising from it; while it has been a prolific breeding place for mosquitoes.

About two years ago the idea of making some use of this marsh meadow was agitated. An investigation was made by engineers, who decided that it could be filled in by means of hydraulic excavators to such a distance above high tide as to prevent its being submerged, and could thus be utilized for a town site, or for some other purpose. The question next arose as to the best method of obtaining the enormous amount of material which would be required to raise the meadow to the proper altitude. With the approval of the government, it was decided to entirely remove a section of the formation adjacent to Cold Spring Inlet—to form a harbor of refuge for sea-going vessels, by enlarging the inlet from its present depth of 8 feet at low tide to a minimum depth of 35 feet, the average depth of the harbor to be at least 35 feet. An idea of the extent of the project can be gained when it is stated that the area to be filled in comprises about 5,000 acres, extending about four miles north and south with a width varying from one to three and a half miles. All of this land is to be raised to a minimum height of 15 feet above its ordinary level, allowing sufficient grade for the construction of suitable sewerage and drainage systems. The section of meadow which will be entirely removed contains nearly 500 acres, and most of it will be excavated to a depth of nearly 40 feet below the surface of the water, in order to secure sufficient "filling" for the town site. The Galveston project calls for the moving of about 11,000,000 cubic yards of material; but that at Cape May will require the removal of over 30,000,000 cubic yards before it is entirely completed, and will probably be the most extensive excavation project which has yet been attempted in the United States.



Interior of the Ladder, Showing Shaft Driving the Agitator and the Bearings in Which the Shaft Rocks.

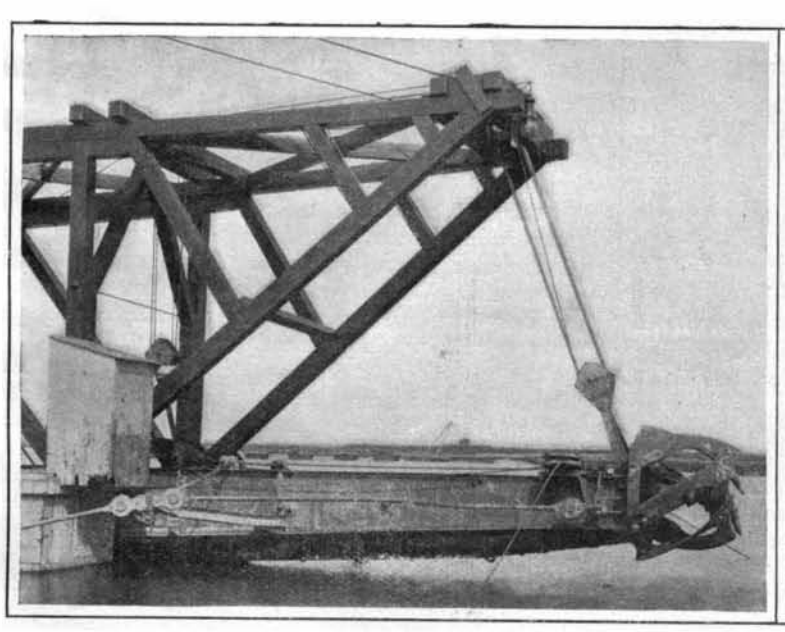
The Discharge End of the Pipe.



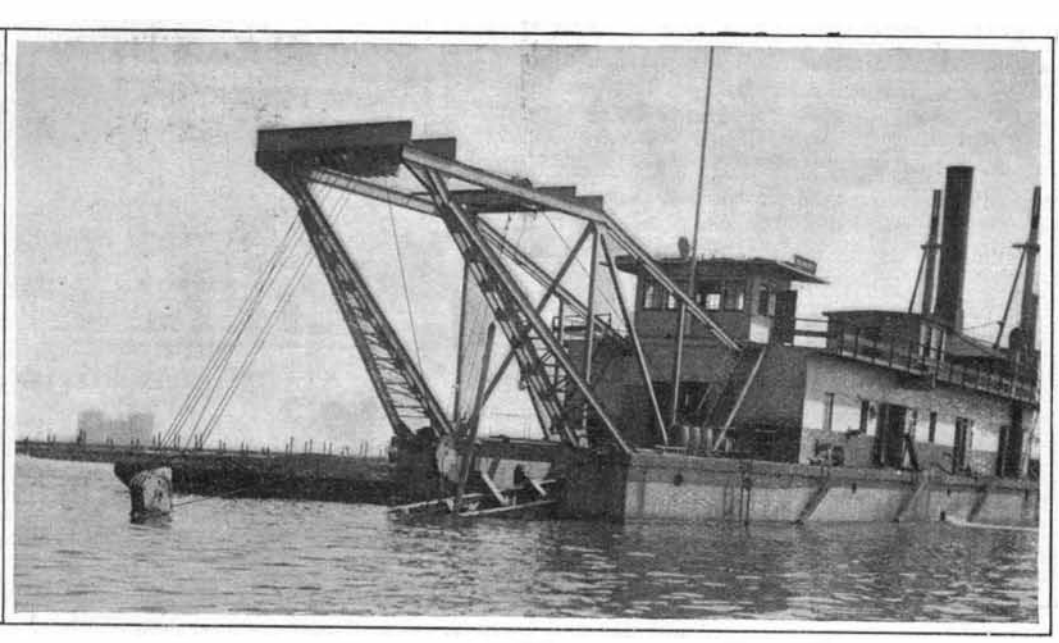
Stern View of the "Mackenzie," Showing Discharge Pipe.

In the scheme at Cape May it may be said that the marsh land is literally turned upside down—but a small portion of the material on the surface being available for filling, and the bulk of it being secured from below the water level. To excavate and remove the material a type of excavator has been placed in service which differs radically from the majority of machines of this class. Perhaps the most interesting feature of the type of dredge that is employed is the agitator, by which the material is loosened and separated. This is a powerful circular cutter consisting of curved steel blades set in a framework which is designed on the principle of the ordinary cutter on a lawn mower. The outward end of this cutting head on the largest dredge is 8 feet in diameter and 6 feet in length. As the illustrations show, it is attached to a steel shaft leading backward to an engine mounted on the front portion of the dredge, which is used exclusively to revolve it. This engine is of 200 horsepower. The cutting head and its driving cylinder are suspended in what is termed a ladder, which is set into the forward portion of the hull and is connected by swinging joints, so that it can be raised and lowered by a block and tackle extending from the outward end of the ladder over a heavy wooden framework bolted to the hull. On the largest dredge in service, the "General Mackenzie," this ladder is 75 feet in length. It also supports the suction pipe leading into the cutting head. The pipe is 30 inches in diameter, and it is connected with a centrifugal pump which is driven by a three-cylinder engine of 1,500 horse-power, the cylinders being 42, 28, and 14 inches in diameter respectively. The discharge pipe served by the pump is also 30 inches in diameter. It is constructed in sections, and it is supported in the water upon pontoons in the usual manner.

As may be imagined, this excavator is of very large capacity. It will take out 10,000 cubic yards of material in a day of ten hours, and discharge it at a distance of 7,000 feet, or over one mile from the point of excavation, if desired. When in service, the excavator works entirely upon the submerged formation. The cutting head is pressed against the bank, and rapidly disintegrates the earth and other material, causing the portion above to become undermined and fall into the water, where it becomes so loosened that it can be drawn through the suction pipe in a semi-liquid state, and readily carried to the point of discharge. Each of the excavators is moored by spuds of Oregon pine, and can be readily handled



Agitator Lifted, Showing Design of Cutting Head.



The Agitator and Suction Pipe Submerged and in Operation.

by means of swing lines, which are controlled by auxiliary engines devoted entirely to this purpose. All of the larger dredges are provided with individual electric light plants; so that the work can be carried on night and day if desired. On the largest excavator a crew of fifty men is employed, divided into shifts of eight hours each. This number is sufficient for all purposes requiring manual labor.

As fast as the meadow is filled in to the requisite height, the pipe lines are removed to another section. Around it is constructed a dam of earthwork, with openings or weirs left at frequent intervals through which the water escapes. On the section of the filled land nearest the ocean, the water discharged through the conduits has been carried into the sea by means of a pipe line. By employing this method, the only work required, except that performed by the excavators, has been to grade the surface with horse machinery. Fortunately, most of the material which has been taken out of the meadows consists largely of sand, from which the water escapes quickly, leaving a dry and firm formation. Already an eight-story hotel has been constructed upon this made ground without any difficulty due to settlement.

It can well be said that a new city is being created upon this worthless salt marsh, for the portion which is being filled in is of sufficient area to allow 7,500 dwellings to be erected in addition to the necessary space for streets and avenues. A sewerage system is being constructed which will drain into Delaware Bay; but owing to the slight fall, the system will be served by a pumping station having a capacity for handling 360,000 gallons an hour. At the present time, five excavators are removing the marsh to a depth of about 40 feet at the rate of ten acres a month. It is an interesting fact that the largest of these dredges, which was designed by Mr. Frank Furst, of Baltimore, was built at Orange, Texas, and towed up the Atlantic coast to Sparrows Point, where its machinery was installed. It was then taken by sea to the present scene of operations. This excavator probably has the largest capacity of any in the world for removing material by the suction method. The work is being performed under the supervision of Ellis Thompson, chief engineer, and Charles W. Tarr, resident engineer.

A CURIOUS ILLUSION.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

When we are looking at anything, the image of what we see paints itself on the retina as it would on the ground glass of a photographic camera, upside down. Through some nervous process we invert again the upset image and set it or rather see it right. In the following experiment the opposite operation is made. An image which, through some artifice, is made to paint itself right side up on the retina is turned over by the general upsetting process and appears to us to be upside down.

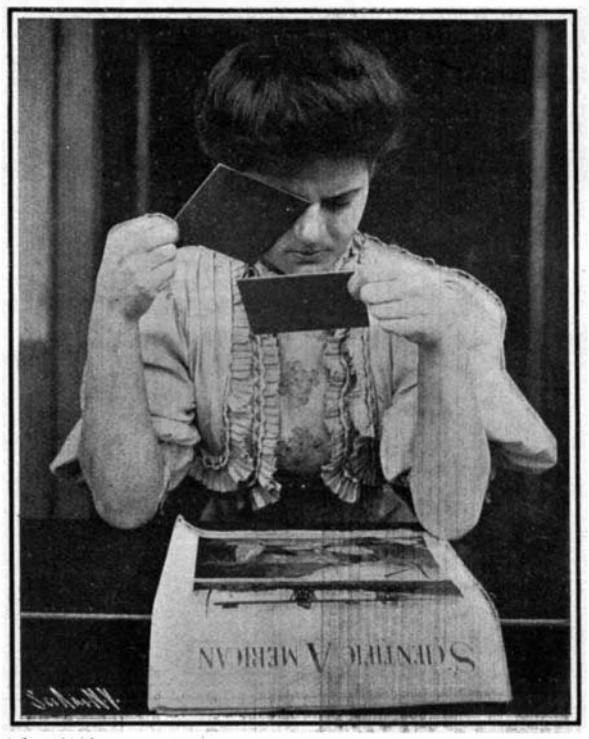
Take two pieces of dark-shaded pasteboard. In the center of one, bore a pin hole. Near a corner of the other make a cluster of three pin holes arranged about as the angles of an equilateral triangle, and at a distance of about 1-16 of an inch from one another. Lay on the table before you a well-lighted sheet of printed matter. Place the card with the three holes in contact with your eye, and through the cluster of three holes look at the center of the other card, this being placed between your eye and the printed matter at a distance of from two to four inches from your eye.

The cluster of holes through which you are looking will then seem to you to be a single aperture and the single hole in the center of the card which you hold far away from your eye will seem to you to have vanished but, instead of it, you will distinctly perceive, on the same card, three holes through each one of which you can easily read a different part of the printed text. These three holes are unlike those which you made on the card kept near your eye, for if the latter are arranged thus: ∴ those on the card which you examine will be arranged in the opposite way: ∴ and *vice versa.*

As the single luminous hole on the card you hold at a distance from your eye is still abnormally close to it, its image will be formed behind the retina or, in other words, the rays will strike the retina before meeting. In ordinary circumstances this fact causes the image to be blurred, but as, in this case, only thin pencils of light are admitted, the rays of which they are made may be considered as nearly parallel and a tolerably good image of the hole will be formed even at some distance of the point where the rays meet. Photographers take advantage of that property of a thin pencil of light whenever they use a small diaphragm to get "depth of focus." Moreover, as the pencils themselves strike the retina before having crossed each other, the triangle they form on the retina is arranged just as it is on the card, right side up. The nervous element, however, blindly upsets this image as it does upset ordinary inverted images, and this gives us the queer sensation of seeing upset what we know to be erect.

If the card with the central hole is now slowly drawn farther away from the eye the three luminous holes get nearer each other and finally unite into one and the same image. The position of this coincides with that of the retina.

At that stage of the experiment, if the observer is short sighted, even to a slight degree, he will find that, on withdrawing the card still farther, nearly at full arm length, the three luminous dots reappear, but, this time, right side up. Owing to an abnormal



A CURIOUS OPTICAL ILLUSION ILLUSTRATING INVERSION OF IMAGES.

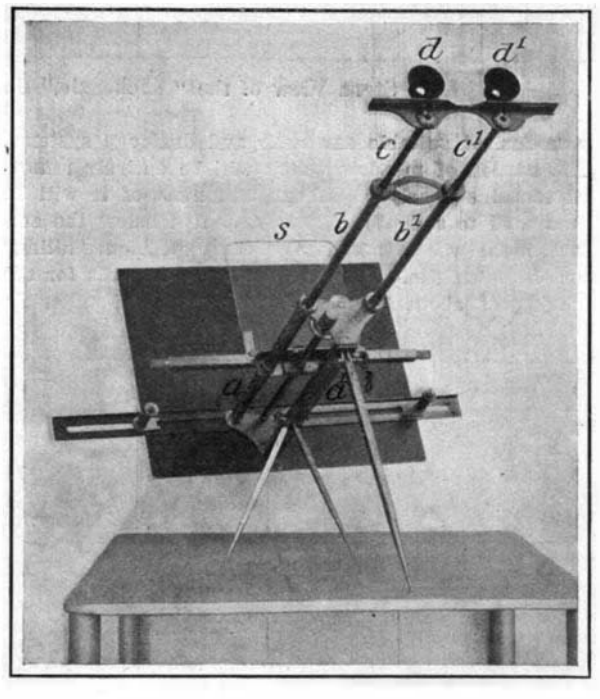
convexity of the crystalline lens the image is formed before the retina; the luminous pencils have crossed each other before striking the retina; the image is inverted; the eye inverts it again and it is therefore seen right side up.

AN X-RAY STEREOSCOPE.

BY DR. ALFRED GRADENWITZ.

In connection with the use of X-rays for medical purposes one of the most important tasks, as is well known, is to ascertain the location of foreign objects in the human body. Now the depth of such foreign bodies can be generally found only by taking two views from points ninety degrees apart. However, this process is frequently rather troublesome, requiring as it does a placing of the patient in different positions, which is not always practicable. Moreover, the heavier bones frequently prevent the taking of such views.

Endeavors have therefore been made of late to produce stereoscopic X-ray diagrams, and to determine



THE X-RAY STEREOSCOPE INVENTED BY DR. GILLET OF BERLIN.

from the plastic picture the desired depth. In this process, however, which has been applied with more or less success, the relief is only apparent, being due to the lack of sharpness of a combined picture produced by superimposing a negative and a positive X-ray diagram. The results derived from the inspection of such pictures thus hardly justify the expenditure of time and trouble made in preparing them.

Dr. J. Gillet, a military surgeon, of Berlin, has suggested a novel method, dispensing with the production of relief effect and securing in place thereof an accurate measure of the depth in question. The "X-ray stereometer" invented by him and constructed by Heinz, Bauer & Co. is based on the well-known principle of stereoscopic vision.

If two corresponding stereoscopic picture points (that is to say, two corresponding points on photographs of the same object, obtained by displacing the objective through the distance between the eyes) be inspected in such a way that the left-hand picture is observed by the right eye, and the right-hand picture by the left eye, the convergence of the optical axes will result in the two corresponding points being combined to a stereoscopic picture suspended in space, the crossing being the point at which the picture appears. This point can be located in the following manner with the naked eye:

A pointed object, e. g., a pencil, is kept midway between the two corresponding points, immediately in front of the latter, and while the pencil is slowly approached toward the nose at right angles to the plane of the picture, both eyes should attempt simultaneously to fix the picture points and the point of the pencil, when the former will be found to approach each other more and more as the pencil point is moved away from them until they finally coincide with the latter at a single point, the crossing in question. Whenever the pencil is moved a short distance sideways, forward, or backward, the crossing is at once decomposed into two different points, thus showing the accuracy with which this point is located.

The distance of the crossing from the two corresponding picture points is dependent on the distance between the eyes and the picture and, on the other hand, on the mutual distance of the axes of the eyes, being the greater as the latter is smaller and the former greater. The distance of the eyes from the picture has, however, alone to be taken into account in ordinary practice, the mutual distance of the axes of the eyes being generally constant, viz., equal to about 65 millimeters (2.6 inches).

From the above, it will be readily understood why it is only necessary to prepare two corresponding X-ray diagrams with a lateral displacement of the X-ray bulb of some 65 millimeters, in order immediately to read (after adjusting for the crossing with the naked eye) the distance between the X-ray plate and the foreign body in question; the vertical distance between the anticathode and photographic plate (viz., the focal distance) should obviously be given.

The parallel extensible brass tubes *a a′*, *b b′*, *c c′*, consisting of three sections, correspond, when fully extended, to a focal distance of the X-ray tube of 24 inches, which, after folding *c c′*, decreases 20 inches, and after also folding *b b′* from 4 inches to the smaller focal distances of 1.6 inch and 1.2 inch respectively.

The glass plate, *s*, provided with a vertical millimeter scale, serves as searcher, and is adjusted longitudinally of the instrument and transversely of the X-ray shade of the foreign body in question, by means of two special pinions. The millimeter scale plays the same part as the pencil point in the fundamental experiment described above, allowing the depth of the stereoscopic image to be determined. By means of two pointers the foot points of the stereogram can be so adjusted with regard to the lenses *d* and *d′*, as to be traversed by the lines of vision striking the picture. These lenses, secured to the front ends of the brass tubes, *c c′*, are situated apart a distance of 2.6 inches.

Measurements are carried out by means of the apparatus in the following manner:

The X-ray stereogram, covered with a squared celluloid sheet, is so adjusted that its foot points coincide with the pointers. The tube having then been drawn out to the actual focal distance, the stereoscopic picture should be searched by means of the glass plate, *s*, until it is cut by the vertical black line on the glass scale. The distance of the glass plate from the stereogram should finally be read on the millimeter scale, whereby the distance of the foreign body will be obtained.

This process, it is true, implies the capacity of stereoscopic vision, that is, the capacity of imparting to the axes of the eyes a certain convergence toward the center. In the case of observers lacking this capacity or having no practice in this respect, the process will be a little more complicated:

The right eye having been closed, the glass scale should be so adjusted by means of the left eye that its black middle line passes through the right-hand shadow of the object in question. The left eye should next be closed and the right eye be used in the same way for adjusting the left-hand shadow. After thus finding a position of the middle line in which both requirements are complied with without any alteration, that is, simultaneously, the scale line will have been brought to the proper position, and by simply reading its distance from the plate on the scale of the pinion, the height of the foreign body above the surface of the plate will be found.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HAT-GUARD.—H. SAUNDRY, New York, N. Y. The purpose of the inventor is to provide a guard applicable to any form or type of hat and comprising a strap and retaining sections, these sections being permanently attached to the hat in such manner that while securely held in position they are concealed, and the strap section being of such character that it can be expeditiously attached to or detached from the retaining sections.

Electrical Devices.

ELECTRIC ALARM-CLOCK.—J. F. RODGERS, New York, N. Y. The object of the invention is to provide a new and improved electric alarm clock more especially designed for use in factories and other places, and arranged to give an alarm at predetermined hours, such as indicating the time for starting and quitting work.

PORTABLE ELECTRIC-LIGHT CABINET.—H. H. ROBERTS, Lexington, Ky. It is especially designed by the inventor to provide a portable apparatus which the patient can apply himself to the various parts of the body in home treatment and which shall be so constructed as to be conveniently handled and applied and which will permit various colors of light to be separately or simultaneously used and which shall be free from all risk of fire.

ELECTRIC HEATER FOR METAL-WORKERS.—J. O. LUTHY, Austin, Texas. The invention is an electric heater of novel construction of parts and certain reagents forming a bath for utilizing the electric current through the bath to raise to a red heat any piece of metal plunged into this bath. It enables blacksmiths, machinists, and other metal workers to quickly and conveniently heat metal to a welding temperature without the use of a forge or a fire.

Of Interest to Farmers.

CATTLE-GUARD.—C. LONG, Paha, Wash. The invention pertains to improvements in cattle guards designed to be placed at railway crossings or at other points along a railway, an object being to provide a guard of simple construction, that will prevent the crossing of cattle and without danger of hurting the animals' feet.

DISK HARROW.—C. N. CASS, Spangle, Wash. One purpose of the inventor is to construct a disk harrow or similar implement in two sections, a forward and a rear section, and providing means whereby the sections can be adjusted independently or relatively to each other and held in adjusted position, the parts being released for adjustment by the driver but the actual adjustment being performed by the team.

HAY-STACKER.—D. D. OGILVIE, Lee, Nev. The aim in this case is to provide a form of stacker, adapted especially for stacking hay from buck rakes, and to so construct the machine that the fork conveyer can be speedily and conveniently raised and lowered, and wherein when the conveyer reaches the highest point in its ascent it will automatically discharge its load in such manner as to deliver the hay in the middle of the stack, rather than at one side, as most stackers do.

CULTIVATOR.—J. J. STALDER, Meade, Kan. Mr. Stalder's invention refers to improvements in cultivators and more particularly to that class of cultivators designed to cultivate alfalfa closely, destroying weeds, grasses, etc., without destroying the alfalfa plants. The cultivator may be used for other purposes.

PLOW.—R. J. VICKERY and J. J. DINSMORE, Clark, S. D. The invention is an improvement particularly in plows arranged in gangs. The implement may be connected with any suitable form of traction engine to which end the inventors secure to the front side of the draft bar a triangular wooden draft frame connected to the draft bar and having a central iron draw bar extending across the frame at the middle thereof and provided at its front projecting end with an eye which may be coupled with the traction engine or other draft apparatus.

Of General Interest.

STRINGER FOR STAIRCASES.—C. F. STEIBER, New York, N. Y. In the present patent the invention has reference to stringers for staircases and the like, and the object of the improvement is the production of a stringer having joints of an improved form, giving the stringer great durability and strength. At points along the facing stringer the material is pressed to give an ornamental finish.

DENTAL INSTRUMENT.—A. B. PRENTIS, Marshfield, Ore. This instrument or appliance is adapted for holding the tongue and cheek away from the teeth while being filled or crowned and preventing access of saliva to them. The instrument may be quickly applied in the position required for use, and causes no discomfort to the patient.

SAFETY OR RESTRAINING DEVICE.—MABEL E. MCCALMONT, Warren, Pa. The device is especially designed for use in hospitals and asylums, or by the general nursing and medical profession, for restraining the movements of the delirious, insane, or unruly, including infants and children, who have to be held or restrained in bed, and the invention relates particularly to restraining of limbs, arms and legs, of the patient.

BRICK-SUPPORTING PALLET.—B. JACQUART, South River, N. J. The invention relates to brick-supporting pallets and to a truck for passing the same into and out of the kiln. In reference to this invention it may be stated that a lot of 10,000 of these pallets have been in daily use for over seven months without giving any trouble for repairs.

CEMENT.—T. JONES, Acme, Texas. The object of the present invention is to produce a material of the general nature of so-called Keene's cement, this inventor's product being a material of the highest grade and excellence and made by the most direct and economic method. Only one calcination is employed. Plasticity and ultimate hardness are brought about by chemical substances added together.

PROCESS OF MAKING SMOKELESS POWDER.—M. A. G. HIMALAYA, Washington, D. C. The invention relates to an explosive, composed of chlorate of potash, starch, and a siccative oil. It consists in a novel process in which chlorate of potash in an impalpable powder is incorporated in the grains of starch without gelatinizing or destroying the structural grains of the starch.

APPARATUS FOR REFINING, AGING, MELLOWING, AND PURIFYING ALCOHOLIC LIQUORS.—J. F. DUFFY, Chicago, Ill. One purpose of the improvement is to perfect a system in which automatically-operating agents are involved for aging, refining, mellowing, and purifying wines and liquors, the method employed being a continuous one, commencing at the still or rectifiers, and ending at the receiving tank or cistern from which the liquor is drawn off into barrels.

FOUNTAIN-PEN.—F. Y. BRENTON, Belleville, Ontario, Canada. The invention refers to fountain pens such as are used chiefly for the purpose of marking goods or packing cases. The object is to produce a pen of this class which will provide a reservoir for the ink, and which will provide means for feeding this ink in sufficient quantities to the penpoint.

FINGER-GUIDE.—J. A. EVANS and J. F. WOLFF, Deer Lodge, Mont. The invention refers to instruments of the cornet or horn type, and its object is to provide a guide arranged to prevent or check all superfluous or upward movement of the player's fingers when raised from the actuated valves, thus facilitating speedy and difficult fingering of quick passages in the piece to be played.

EQUALIZING APPARATUS.—C. C. GRIMES, Haskell, Ind. Ter. In this patent the invention is an improvement in equalizers comprising in connection with the platform and the frame in connection with which said platform is movable, means whereby the platform may be retained in the same plane or planes parallel to its normal position when depressed at any point throughout its surface. The invention can be embodied in a bedstead and employed in supporting car beds, wagon beds, in buffers, and the like.

Hardware.

MASONRY TOOL.—P. J. COURTNEY, Elizabeth, N. J. The objects among others in this case are the provision of a tool for handling the mortar in building construction, and forming the joints of the same between several layers of building material. The inventor has combined with an ordinary trowel, in a manner that its usefulness is not impaired, a jointer, comprising beads so arranged that they can be brought into action without inconvenience or loss of time as is attendant when these functions are performed by separate devices.

LOCK-BOLT.—U. G. SMITH, Lansford, Pa. The purpose of the improvement is to provide a very simple and effective lock bolt adapted as a locking bolt and nut for an end of a vehicle axle, for example, or for use wherever an ordinary bolt and nut is applicable and it is desired to lock the nut and bolt against turning.

Heating and Lighting.

SHIELD FOR HEATING-COILS.—P. S. KNOTH, New York, N. Y. The coils are such as are used in schools, offices, stores, and other buildings and places, and the object of the invention is to provide a shield arranged for convenient and quick attachment to the coil without requiring any addition or a change in the construction and arrangement of the heating coil.

CARBID-FEED FOR ACETYLENE-GAS GENERATORS.—N. D. SHAFFER and J. S. BENTON, Johnstown, Pa. The feeder comprises a main discharge pan, and an interrupter or cut-off pan, rigid with said pan and both of said parts being secured to a shaft by the rocking or oscillation of which the desired operating movement may be given to the feeder. When properly proportioned to the size generator it is to feed, the device will drop approximately a uniform amount of carbid at each operation.

MINER'S LAMP.—R. L. GRAVES, Sumpter, Ore. This lamp is adapted for burning paraffin-wax or other solid fuel. With a heat-conducting wick tube, the fuel is retained in fluid condition no matter into which direction the flame is blown, since in any deflection of the flame, one or more of conducting extensions would receive heat, and the same be conducted into the lamp-body to the tubular portion of the wick-tube, keeping the latter suitably heated for retaining the fuel in melted fluid condition.

Household Utilities.

BATH-CABINET.—JEANNE E. FRANCOUER, San Francisco, Cal. This cabinet is organized with another piece of furniture such as a bureau, a desk, or a chiffonnier, so as to be completely housed and concealed, and present the appearance of an ordinary piece of furniture, and giving at the same time the advantages of two or more pieces of furniture in one construction and thereby greatly economizes space so that it may be located in a bed room or office without either offending the eye or losing for other purposes the value of the space it occupies.

COOKING APPARATUS.—J. R. ADAMS, Kenosha, Wis. The invention relates to containers adapted to receive vessels of partially cooked food, which after having been brought to the boiling point or cooked for a short length of time in any suitable manner are tightly sealed and inclosed within the walls. The heat retained in the vessel of partially cooked food is thus prevented from being dissipated and the food continues to cook for a considerable length of time. Steam is prevented from escaping to moisten, warp, or soil the device.

SAD-IRON.—J. F. WILLEY and E. W. WATSON, Versailles, Ill. The object of the improvement among others is the provision of a comparatively cheap, simple, and effective self-heating iron, presenting a neat appearance without any overhanging or cumbersome parts likely to interfere with its proper use. This object is accomplished by the invention.

Machines and Mechanical Devices.

SEWING-MACHINE HEMMER.—THERESE S. ZACHAIRA, New York, N. Y. In this patent the invention relates to hemmers designed to be attached to sewing machines, and has for its object to provide means simple in construction, effective in operation, and adapted to readily form a hem of any desired width. The device is preferably attached to the presser foot of a sewing machine and disposed in front of and adjacent to the stitch forming mechanism.

ADJUSTING DEVICE FOR CAMERA LUCIDAS.—A. TAYLOR, New York, N. Y. The object in this instance is to dispense with disadvantages found in adjusting devices now in general use. This is accomplished by means of an adjustable clamp adapted to be attached to the body tube of a microscope, instead of to the draw tube, and mechanism mounted upon said clamp, adapted to support a camera lucida, and adjust the axis of said camera relatively to the axis of the microscope.

CLAMPING DEVICE.—C. L. SIMMONS, Davenport, Wash. The purpose in this case is to provide a device or cradle, for convenient attachment to monuments, pillars, and like heavy articles and for securely gripping the same, to permit of hoisting or lowering the article in the quarry, shop, cemetery or other place, and without danger of the article toppling over or the clamping device becoming loose or detached.

POWER TRANSMISSION.—G. S. BLUEBAUM, Billings, Mo. The invention pertains to devices for converting reciprocating motion into rotary motion, and its aim is the provision of power transmission more especially designed for transmitting the power of wind mills and like motors to other machinery, and arranged to steady the motion when the motor runs light or heavy.

HANGING STAGING-HOIST.—H. O. CLARKE, Pittsburg, and A. G. Ross, Wilkinsburg, Pa. This hoist is adapted to be suspended at the side of a building and used by brick masons, painters and others. The inventor aims to produce a device capable of easy, vertical adjustment, especially avoiding complicated and expensive mechanism or such as would interfere with the free movement of the workmen on the stage or platform.

WASHING-MACHINE.—I. N. CONNELL, Baileys Mills, Ohio. The intention in this improvement is to provide a machine which is simple in construction, effective in operation and durable in use, adapted to be handled by the most unskilled person without injuring the finest or coarsest fabrics contained therein, and capable of being operated with the least possible strength and exertion.

VIBRATING ROLLER FOR PRINTING-PRESSES.—E. NICHOSON, 623 West Hillsdale Street, Lansing, Mich. One of the purposes of this invention is to provide a color vibrator for printing presses adapted for use in connection with distributing rollers where different colors are to be printed at one impression, and to provide a device capable of being quickly and conveniently set up for adaptation to any number of colors, and to act in conjunction with distributing rollers of the ordinary type.

VERTICAL-SPINDLE MOUNTING FOR WOODWORKING-MACHINES.—A. MAYER, Winton, Minn. This improvement has reference to the mounting of the vertical spindles of woodworking machines, and especially applicable in connection with the mounting of the vertical spindles which carry the cutters used in finishing the edges of lumber, or in cutting matching tongue grooves.

PULLEY.—J. B. DUNLAP, Tulsa, Ind. Ter. More particularly this invention relates to drive pulleys for shafting, but comprehends the general subject of gear-wheels and similar driving or driven wheels. It is directed to the pulley or gear-wheel fastening means and also to a peculiar construction of a two-part hub.

POST-HOLE DIGGER.—D. A. GRAY, Chattanooga, Tenn. In the operation of this machine the connecting rods being preferably set to regulate the depth of the cut as desired, the drive shaft may be turned, thus operating to turn the cutter to form a hole of the desired depth. Lugs are provided with clamping screws so that when desired the casing may be held upon the main shaft with the springs under tension.

GRAIN SEPARATING AND VITRIOLIZING MACHINE.—A. R. FERGUSON, Colton, Wash. The invention refers to improvements in machines for separating wild oats from wheat, barley, or other grain, the main object being to provide means for treating the grain with a cleaning solution to kill the smut germs, thus promoting the growth of the grain.

Prime Movers and Their Accessories.

TURBINE.—E. L. SCHAUN, Baltimore, Md. Broadly stated, this apparatus involves a turbine of the radial flow type and which is coupled with an air compressor arranged to store air under pressure, which air is utilized for starting the turbine, and when that operation becomes normal the air is employed to mix with a fuel forming a combustible compound which is burned in the combustion chamber of the apparatus, the expanding gases resulting from such combustion being directed through the turbine to drive the same.

ROTARY ENGINE.—H. L. BAKER, Greenville, and L. E. IRISH, Belding, Mich. The invention consists in the construction and arrangement of abutment valves; in the construction and arrangement of the revolving piston; in means for connecting this piston to its driven shaft, and also further in the special combination with the piston, cylinder, shaft, and governor of a concentrically arranged cut-off valve for automatically adjusting the admitted steam to the load and using the steam expansively.

FIRE-BOX FOR STEAM-BOILER FURNACES.—J. LIVINGSTONE, Montreal, Canada. The inventor designs, first, to contribute to the strength and stability of the boiler around the fire-box by maintaining, while in service, the natural elasticity of the material, avoiding the burning of the inner ends of the stay-bolts and avoiding strains which exist between the stay-bolts and outer and inner walls of the box due to high temperature of unequal distribution. Secondly, to secure more perfect combustion of, usually, unconsumed carbon. Thirdly, to assure continuous production of free hydrogen in the box, and fourthly, to give relief from explosion.

Railways and Their Accessories.

CAR-COUPLING.—A. M. KNAPP, Portland, Ore. This coupling is an improvement in couplings of the Janney type. The curved locking arms, or "knuckles," of such couplings, are subject to wear, owing to lateral and vertical motion of cars, and must be ultimately discarded. To avoid this and attendant expense, it has been proposed to provide the inner sides or faces of the knuckles with a removable wear-piece which can be discarded when worn out, and a new one substituted without doing away with the entire knuckle.

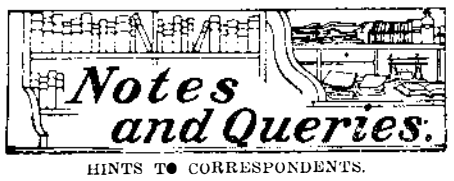
Pertaining to Vehicles.

TONGUE-SUPPORT.—E. C. AYERS, Valentine, Neb. Mr. Ayers's invention is in the nature of a support for wagon tongues, designed to relieve the necks of horses of its weight, and it consists in the novel construction and arrangement of a tension spring, combined with a chain and pulley and means for regulating the tension.

WAGON-TONGUE.—H. B. NOLEN, Lamar, Wash. The purpose of the invention is to provide a construction of tongue especially adapted for use in connection with agricultural implements, which tongue can be expeditiously attached to the frame of an implement in such manner that it will insure the tongue being perfectly rigid and fast to the frame and not liable to displacement under the most severe use. It is a division of the application formerly filed by Mr. Nolen, and for which Letters Patent were issued.

AUTOMOBILE-WHEEL.—B. H. BRIDGERS, Wilmington, N. C. In carrying out the invention, Mr. Bridgers makes the ordinary metallic or wooden wheel rim, having an elastic tire secured thereto, detachable from the spokes of the wheel in place of the same being permanently secured thereto as in the usual construction. Thus, a rigid metallic or wooden wheel rim and an elastic tire secured to it, constitute together a single attachable and detachable member of the wheel.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10535) R. L. M. asks for a remedy for incrustations of boilers. A. Remedies that have been adopted with more or less success for boiler incrustation: 1. Potatoes, 1-50 weight of water, prevent adherence of scale. 2. Twelve parts salt, 2½ caustic soda, ⅛ extract of oak bark, ½ of potash. 3. Pieces of oak wood suspended in boiler and renewed monthly, prevent deposit. 4. Two ounces chloride of ammonia in boiler twice a week prevents incrustation and decomposes scale. 5. Coating of 3 parts black lead, 18 tallow, applied hot to the inside of a boiler every few weeks, prevents scale. 6. Thirteen pounds molasses fed occasionally into an 8-horse-power boiler prevented incrustation for six months. 7. Mahogany or oak sawdust in limited quantities. The tannic acid attacks the iron, and should therefore be used with caution. 8. Slippery elm bark has been used with some success. 9. Carbonate of soda. 10. Chloride of tin. 11. Spent tanners' bark. 12. Frequent blowing off. 13. Paraffin oil has been used with excellent results in locomotive boilers. 14. Marine boilers are sometimes protected from corrosion by a very thin wash of Portland cement inside.

(10536) D. N. asks how to straighten saws. A. You can straighten band saws in the following manner: Put the saw on to the machine and under tension, just as it is to be used. Use a steel straight edge 10 or 12 inches in length, to find the lumps or twists, which mark with chalk, so as to know where to hammer. Now hold the oval face of a millwright's or carpenter's hardwood mallet opposite the chalk marks and against the saw, and with a light oval-faced hand hammer knock out the lumps. Commence carefully, do not strike too hard. Examine your saw often with your straight edge to see how you get along, and you will soon be able to take out twists readily and get your saw perfectly true.

(10537) J. M. W. asks how to true grindstones. A. Drive at a moderate speed and true up with a rod of ½ inch or ⅜ inch iron, or better, a piece of tube. To use it, keep turning the rod or tube, which should be held nearly at right angles, and turns as the edge grinds away. By thus turning it round a new edge is formed all the time that the stone is turned off true. The stone should be dry, not wet. Do not attempt to perform such an operation close to a lathe or other machine without thoroughly covering them up, as the dust flies everywhere and will cause serious damage.

(10538) W. F. I. asks for colors for druggists' show bottles. A. Amber—Dragon's blood, in coarse powder, 1 part; oil of vitriol, 4 parts. When thoroughly dissolved, dilute with cold distilled water till the required tint is obtained. Blue—1. Copper sulphate, 2 ounces; sulphuric acid, ½ ounce; water, 20 ounces. 2. A solution of soluble Prussian blue in oxalic acid and diluted to the right shade. 3. Solution of indigo in sulphuric acid, diluted with water. Crimson—1. Iodine and iodide of potash, of each 30 grains; hydrochloric acid, 1 drachm; water, 1 gallon. 2. Alkanet root, 1 ounce; oil of turpentine, 20 ounces. Green—1. Sulphate of copper, 1 drachm; bichromate of potash, 30 grains; strong liquor of ammonia, 2 ounces; water, 1 gallon. 2. Copper sulphate, 2 ounces; sodium chloride, 4 ounces; water, 1 pint. 3. Solution of verdigris (distilled) in acetic acid, diluted with water. 4. Dissolve blue vitriol in water, and add nitric acid until it turns green. 5. For dark green, chromium sulphate. Magenta—Acetate of rosaniline dissolved in water. Olive—Dissolve equal weights of iron sulphate and sulphuric acid in water and add copper nitrate, q. s. to strike the color. Orange—1. Dissolve bichromate of potash in water and add a little sulphuric acid. 2. Dissolve gamboge in liquor of potassa: dilute and add a little water. Pink—1. To a solution of cobalt nitrate or chloride in water add sesquicarbonate of ammonia, q. s. to dissolve the precipitate at first formed. 2. From madder (washed with cold water), 1 ounce; sesquicarbonate of ammonia, 1 ounce; water, 3 pints, 12 fluid ounces: digest with agitation, for twenty-four hours; then dilute with more water and filter. Purple—1. Sulphate of copper, 2 drachms; water, 2 ounces; French gelatine, 1 drachm. boiling water, 2 ounces; solution of potassa, 2 pints. Dissolve the copper salt in the water, and the gelatine in the boiling water. Mix the two solutions and add the liquor of potassa. Shake the mixture a few times during ten hours, after which decant and dilute with water. 2. A solution of copper sulphate, 1 ounce in water, 1 quart, with the addition of 1½ ounces sesquicarbonate of ammonia. 3. To the last add a sufficient quantity of the first pink, above, to turn the color. 4. To an infusion of logwood, add carbonate of ammonia, q. s. 5. Lead acetate, 3 ounces; cochineal, 1 drachm; water, q. s. 6. Add sulphate of indigo, nearly neutralized with chalk, to an infusion of cochineal till it turns purple. Red—1. Solution of perchloride of iron, 10 drops; sulphocyanide of potassium, 10 grains; water, 1 gallon. 2. Dissolve carmine in ammonia and dilute with water. 3. Dissolve cochineal in a weak solution of ammonia; or in 4. sal ammoniac, and dilute with water. 5. Add 4 ounces sulphuric acid to 1 gallon water, and digest 8 ounces red rose leaves in the solution for twenty-four hours. 6. Dissolve madder lake in sesquicarbonate of ammonia, and dilute with water. Violet—Mix together solutions of nitrate of cobalt and sesquicarbonate of ammonia, adding a sufficiency of ammonio-sulphate of copper to strike the required color. Yellow—1. A solution of sesquioxide of iron (ferric oxide), ½ pound, in 1 quart hydrochloric acid, diluted with water. 2. To a strong decoction of French berries add a little alum. 3. A simple solution of potassium chromate or potassium bichromate. 4. A solution of equal parts of niter and potassium chromate. 5. A solution of potassium bichromate.

NEW BOOKS, ETC.

PHOTOGRAPHIC STUDIOS AND DARK ROOMS. With Numerous Engravings and Diagrams. By Paul N. Hasluck. Philadelphia: David McKay. 16mo.; cloth; 100 pages. Price, 50 cents.

A comprehensive digest of the information on the construction of photographic studios and dark rooms, that has appeared from time to time in the weekly journal Work. The subjects are conveniently arranged, and the instructions contain everything that is necessary for the complete equipment of a photographic establishment.

STAR REDUCTIONS. By W. Ernest Cooke. Perth, West Australia: Perth Observatory.

A description of a new method for the reduction of star places from apparent to mean positions and the opposite.

DISEASES OF SWINE. With Special Reference to the Preventive Measures of Disease. By Robert A. Craig. New York: The Orange Judd Company. Illustrated; 12mo.; cloth; 191 pages. Price, 75 cents.

There is great need for a short treatise on the diseases of hogs, since the literature on the subject is very scattered. Mr. Craig understands his subject thoroughly, and handles it in a simple and satisfactory manner.

PROFITABLE DAIRYING. A Practical Guide to Successful Dairy Management. By C. L. Peck. New York: Orange Judd Company. 12mo.; cloth; 174 pages; illustrated. Price, 75 cents.

A thoroughly practical work dealing with dairying from the modern intensive standpoint. The chapter devoted to "Dairy Breeds" is most interesting.

THE STEEL SQUARE AS A CALCULATING MACHINE. By Albert Fair. New York: The Industrial Publication Company. 12mo.; cloth; 81 pages; illustrated. Price, 50 cents.

The steel square is one of the most widely known tools in existence, yet few of its users are familiar with its possibilities in the broader sense. Mr. Fair's book contains directions on how to test the accuracy of the square, how to use it with the best results, and how to solve a number of difficult problems by its aid. The work is highly to be recommended, for it is only by having a thorough knowledge of his tools, as well as the experience in using them, that the workman can even hope to develop into the artisan.

THE TECHNICAL YEAR BOOK. 1907. Edited by Arthur C. Kelly and Charles Weekes. London: Percival Marshall & Co. 16mo.; pocket size; 399 pages. Price, $2.

A very handy little volume of miscellaneous information; rather more interesting, perhaps, than useful as a pocket reference book. Its value in the United States is limited by the fact that much of the data is purely British in character, and does not apply here.

FOOD MATERIALS AND THEIR ADULTERATIONS. By Ellen H. Richards. Final edition revised and rewritten. Boston: Whitcomb & Barrows. 12mo.; cloth; 176 pages. Price, $1.

The conditions which made the "Pure Food Law" a necessity could never have arisen had it not been for the ignorance and indifference of the buying public. Miss Richards's object is to overcome this indifference and to make a knowledge of foodstuffs and their values so general that the consumption of unwholesome food will be a rare exception. Her book covers all the important aspects of the case clearly and broadly, making a treatise that is neither too simple nor too technical.

MECHANICAL ENGINEERING MATERIALS. Their Properties and Treatment in Construction. By Edward C. R. Marks. New and enlarged edition. Manchester, England: The Technical Publishing Company. 98 pages. Price, $1.

A book midway between the average work on metallurgy and the average work on mechanical engineering. It gives in concise and handy form practical information on the characteristics and capabilities of the materials more generally used in mechanical engineering, so that an intelligent idea can readily be formed of what may be expected of them.

SQUABS FOR PROFIT. A Practical Treatise on the Raising of Squabs from the Egg to the Market. Being a Handbook for the Beginner and a Guide for the Experienced Breeder. By William E. Rice and William E. Cox. New York: The Orange Judd Company. Illustrated; 16mo.; cloth; 117 pages. Price, 50 cents.

Squab raising is far from the easy pastime it may appear to be upon first consideration. There are a thousand and one little details that one must attend to with the greatest attention to achieve success, and it is only after considerable experience that one can obtain continuously profitable results. The pitfalls that beset the beginner may be largely avoided by studying "Squabs for Profit," for it embodies the results of seven years' careful work as squab-raiser on the part of the author.

THE STEEL SQUARE AND ITS USES. In two volumes. Edited under the supervision of William A. Radford, assisted by Alfred E. Woods and William Reuther. New York: Industrial Publication Company. 8vo.; cloth; 500 pages; illustrated. Price, $2.

A complete and systematic treatise on the steel square, in which the principles are given in plain language, so arranged as to be readily available for reference. The text is arranged in progressive chapters with a full list of the contents of each chapter at its head, and the helps and hints, the rules and examples are placed under appropriate sub-headings, with index commencement words printed in boldfaced type, so that the eye of the reader can catch the particular information wanted at once. Original illustrative diagrams to the number of over two hundred are contained throughout the text. The collection of miscellaneous rules and examples given in Volume II. is of great practical utility, as one example in each set is worked out. The work ends with a department of Questions and Answers. All in all, no more complete or more conveniently arrranged work has yet appeared on this important subject.

WELLCOME'S PHOTOGRAPHIC EXPOSURE RECORD AND DIARY FOR 1907.

This little book, neatly and tastefully printed and bound, seems to us a very compact compendium of photographic knowledge, giving as it does excellent information on exposures at home and abroad, besides tables which give the speeds of over 200 plates and films. The book contains a diary for the year, memoranda pages, ruled pages for recording positive exposures and negative exposures formulated for toning by the gold, platinum, copper, and bisulphid methods, development by time, machine, tank, or stand methods, customs regulations, tables for focusing, a temperature chart, tables of weights and measures, and monthly light tables giving the relative value of the light at all hours of the day and throughout the year. Although the book has been evidently compiled for the use of English photographers, most of its information will be found available by the American photographer.

ÆTHER. A Theory of the Nature of Æther and of Its Place in the Universe. By Hugh Woods. London: The Electrician Printing and Publishing Company, Ltd. 8vo.; cloth; 100 pages. Price, $2.

The spirit of modern science is made up of two apparently diametrically opposed influences—the one seeking to establish relations between sets of phenomena by experimental research, the other endeavoring to form foundations for this research by logical use of the imagination—if such an expression may be rightly used. Both branches are equally important, each one aiding the other, although when the facts are established the original hypothesis may be so altered as to be quite unrecognizable. Mr. Woods's work is of the hypothetical kind. He deals with forms that have never been proved to exist, namely, the basal forms of aggregation of matter, although he assumes nothing that is not universally accepted as being in accordance with the facts. The concept of "ether" is not new; Mr. Woods is not setting forth a doctrine that is startling in its wildness; he is showing the relationship among ideas that have been held for many years in separate, disjointed forms. As a whole, the work is of great value, for it is to such thinking that we must look for the solution of the seemingly unsolvable problem of the ether.

SYNOPSIS OF MINERAL CHARACTERS. Alphabetically arranged for Laboratory and Field Use. By Ralph W. Richards. New York: John Wiley & Sons. 16mo.; 99 pages; leather. Price, $1.25 net.

An alphabetical list of minerals and their characteristics and of mineralogical terms. It is bound in such form as to make an excellent reference book for use with determination tables in field work.

A SHORT COURSE ON DIFFERENT EQUATIONS. By Donald Francis Campbell. New York: The Macmillan Company. 16mo.; cloth; 96 pages. Price, 90 cents.

Only to those who have a knowledge of the fundamentals of the calculus will Dr. Campbell's textbook prove serviceable. It is far too advanced for beginners, and of rather too limited a scope for the student who wishes a broad view of the subject. For the engineer, however, to meet whose needs it was written, it will prove a great saver of time and energy, since the subjects dealt with are only those whose principles are constantly met with in the practice of engineering.

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AND EACH BEARING THAT DATE

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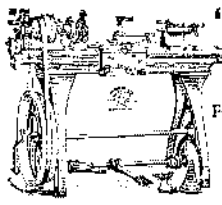

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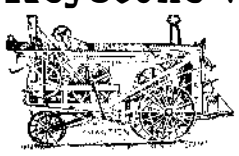

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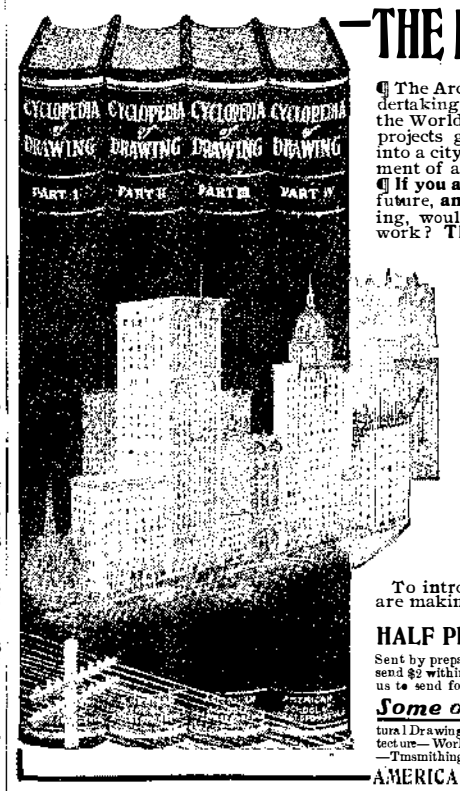

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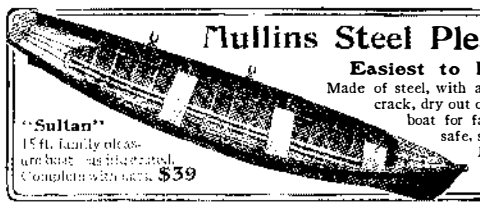

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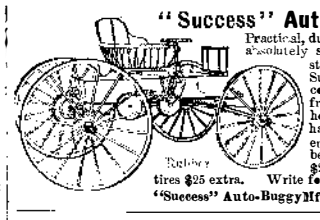

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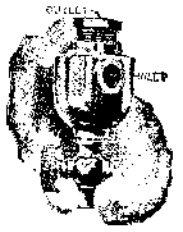

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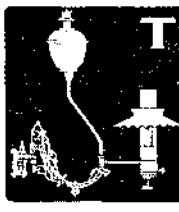

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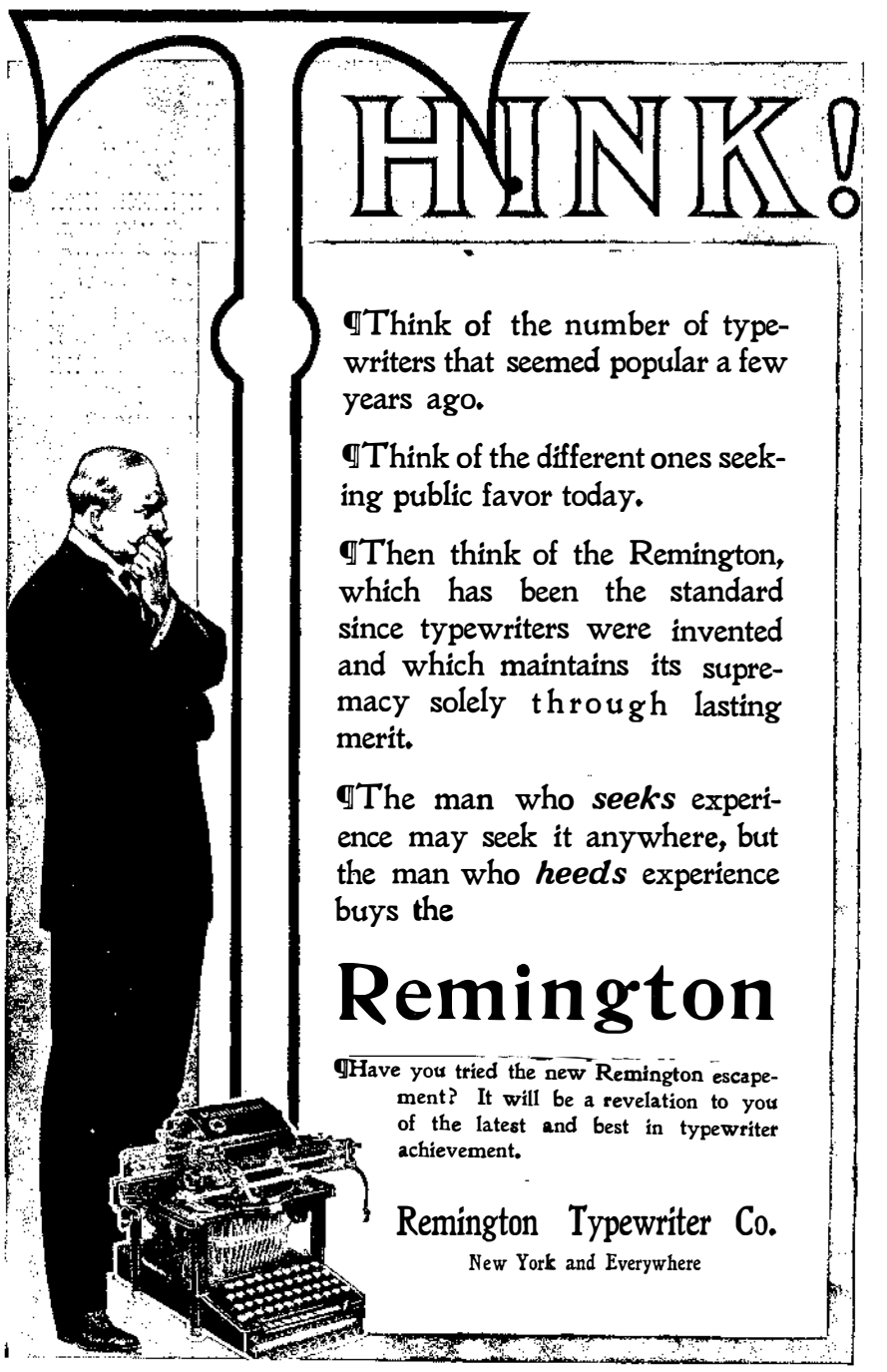
Measuring device, O. Caviglia 853,768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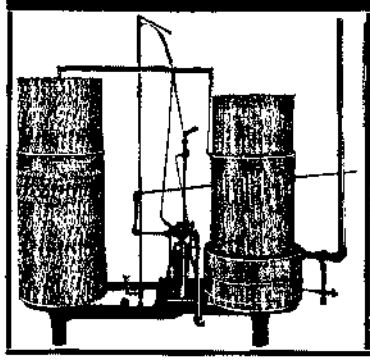

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You can have ignition current for your automobile or motor boat at any time for starting, running or reserve by installing an Apple Battery Charger. Attached to flywheel of engine, it generates enough current to keep storage batteries always charged to maximum electric lights. For full information, write

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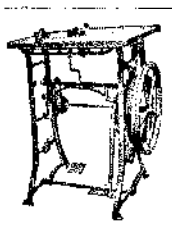

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Is a simple power for light work of the kinds most done by carpenters, cabinet, box, pattern and picture-frame makers, and wood workers generally, besides engravers and electrotypers. This Machine has a strong, solid iron frame and steel shafts; is thoroughly well-built and suitable for various kinds of work, as ripping, cross-cutting, grooving, etc. Can be operated sitting or standing. We also make all kinds of foot power devices.

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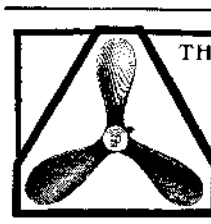

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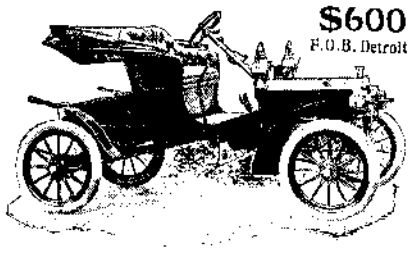
Ask Your Nearest Ford Agent to show you—a demonstration will be a revelation.



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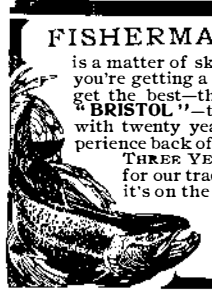

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Pneumatic elevator, K. Bruchle	853,677
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Postal card, souvenir, E. G. Adams	853,853
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Potato eye remover, A. C. Kent	853,306
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Power transmitting device, J. T. Kinkead	853,553
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Printing press, B. W. Morgan	853,590
Propeller, A. Flad	853,233
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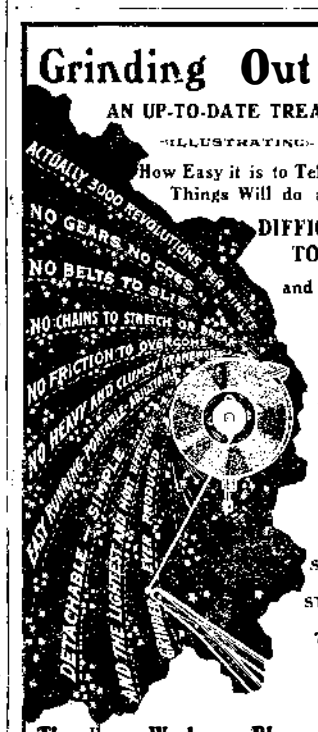

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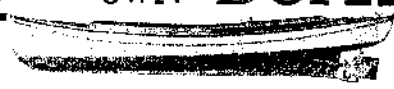

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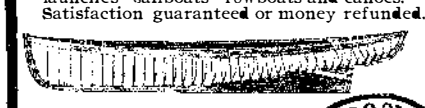

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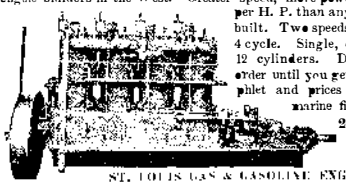

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Stamps, trading, Diamond Trading Stamp Co.	62,572
Tanning, chemical mixtures for, Vacuum Oil Co.	62,629
Tapestry chenille, tapestry, and velour, Moss Rose Manufacturing Co.	62,523
Telephones, Wire and Telephone Co. of America	62,548
Thread and spool cotton, American Thread Co.	62,568, 62,569
Ties, ladies' string, W. Trevor	62,525
Tires, pneumatic bicycle, Fisk Rubber Co.	62,574
Toilet preparation, certain, Frederick Stearns & Co.	62,616
Tools, certain hand, William Hunt & Sons, The Brades	62,586
Turbine rotors and shafting and twyers, Continental Iron Works	62,530
Typewriter ribbons, cloth for, H. Hilker	62,537
Water and flavored soda water, spring, C. C. Burrill	62,519
Waters, ginger ale, root beer, etc., mineral, Blue Ribbon Mining, Milling, and Investment Co.	62,518
Waters, seltzer, and ginger ale, mineral and lithia, Ohio Bottling Co.	62,557
Waxes, oils, and greases, certain, Vacuum Oil Co.	62,516
Whisky, A. Schwabacher	62,524
Whisky, Rock Spring Distilling Co.	62,544
Whisky, J. Klein	62,556
Wine, bitter, M. Kolassa	62,539
Wire, Wire and Telephone Co. of America	62,549

LABELS.

"Amo Wheat Fibre Cups," for breakfast food of cereal grain, W. E. Williams	13,539
"Gold Nugget," for bottled beer, Black Hills Brewing Co.	13,535
"Gold Nugget Extra Fine Special Beer," for bottled beer, Black Hills Brewing Co.	13,534
"Gold Nugget Extra Fine Special Brew," for beer, Black Hills Brewing Co.	13,533
"Golden Gate Ginger Ale," for ginger ale, T. Kornabrens	13,532
"Levey Americas Greatest Cleanser and Dyer," for a fluid cleaning compound, H. Levey	13,544
"Lightning Gold & Silver Polish," for a gold and silver polish, F. F. Spinney	13,543
"Lowney's Assorted Chocolates," for confectionery, W. M. Lowney Co.	13,536 to 13,538
"Oriental Bath Aroma," for a perfume for the bath, Elite Perfume Co.	13,542
"Sanroc Natural Mineral Water," for natural mineral water, Sanroc Springs Co.	13,531
"Southern Poultry Food," for poultry food, Southern Stock Food Co.	13,541
"Southern Stock Feel," for stock food, Southern Stock Food Co.	13,540
"The Edison Magnetized Wire Woven Rawhide," for whips, Cowles Horan Whip Co.	13,545

PRINTS.

"Here It Is," for whisky, Hurd-Wheeler Co.	1,984
"Men's and Boys' Apparel," for men's and boys' apparel, H. C. Lytton	1,985

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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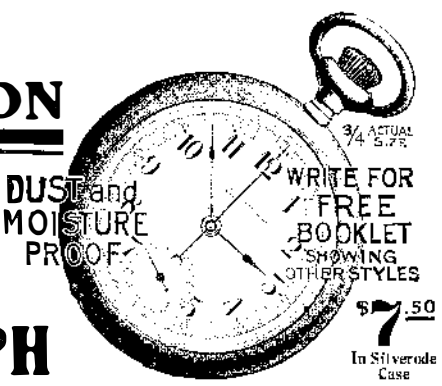

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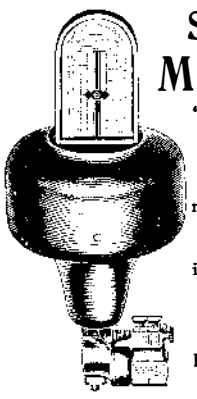

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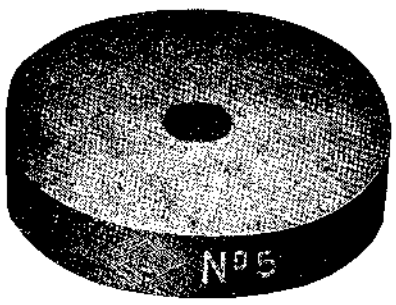

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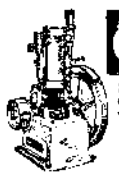

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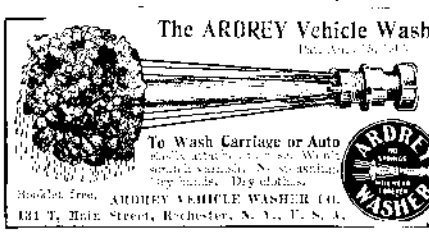

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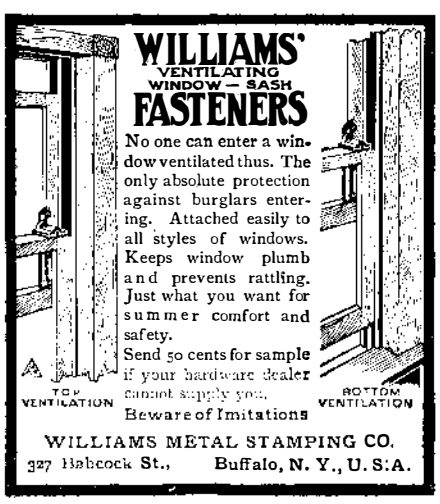

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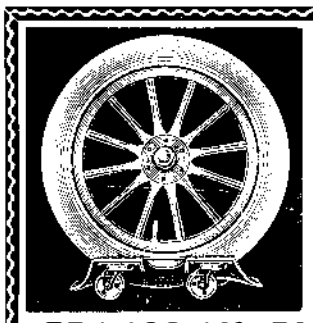

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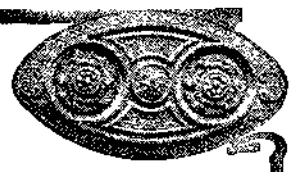

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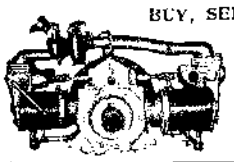

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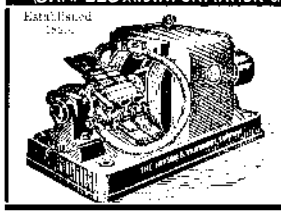

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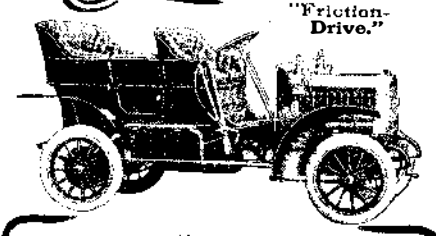

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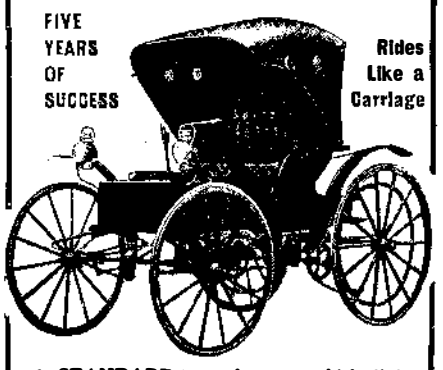

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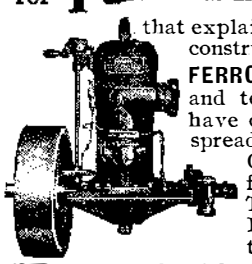

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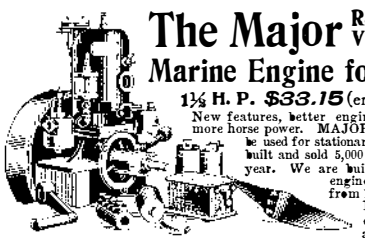

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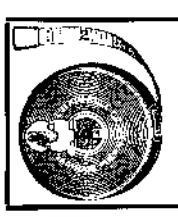

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